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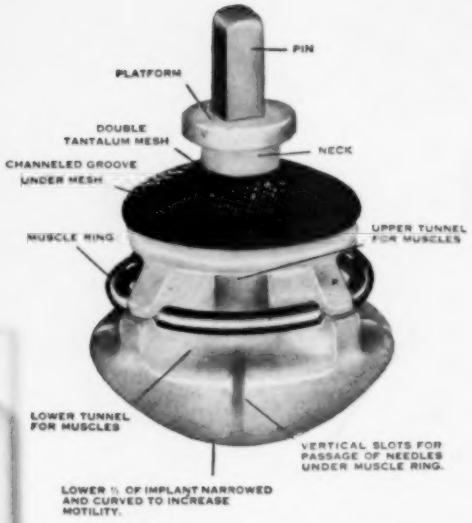

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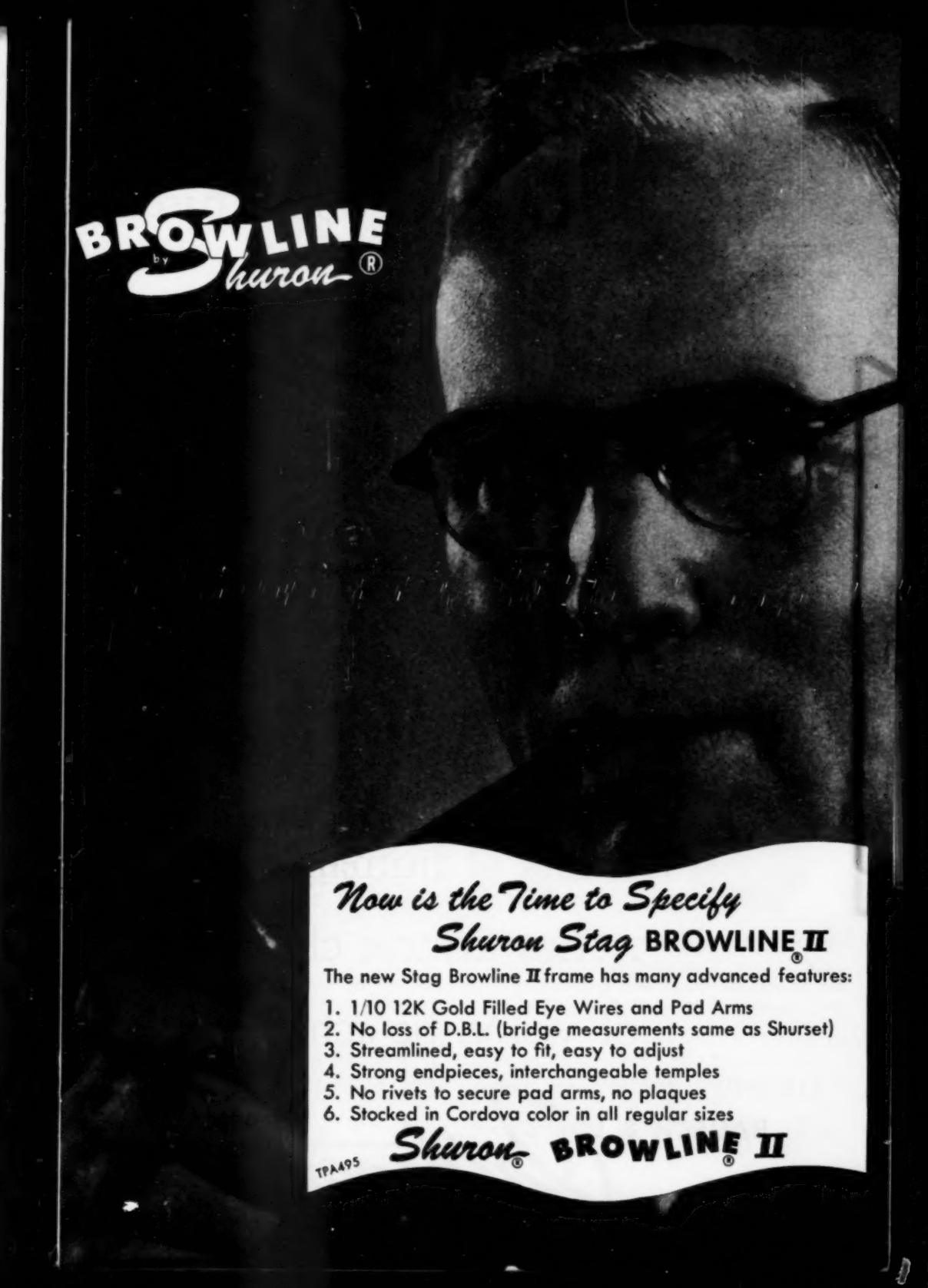

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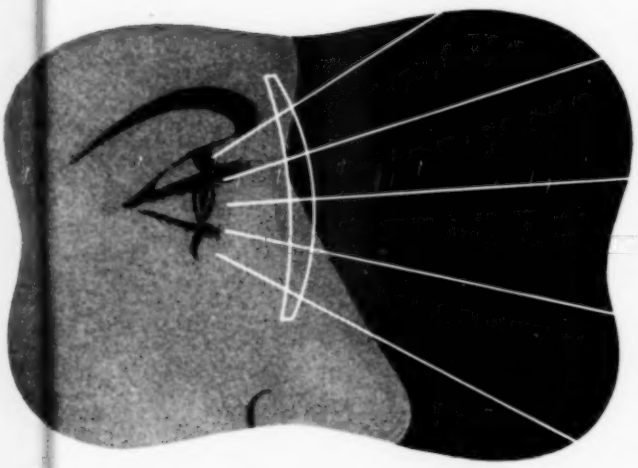

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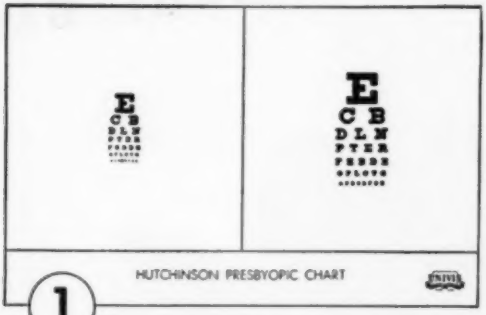

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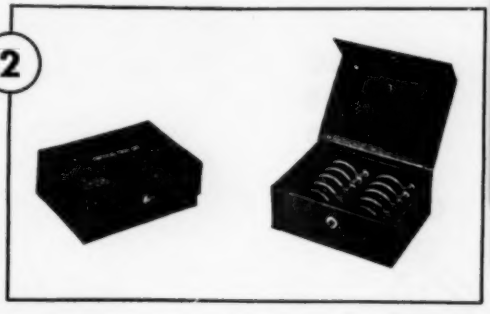

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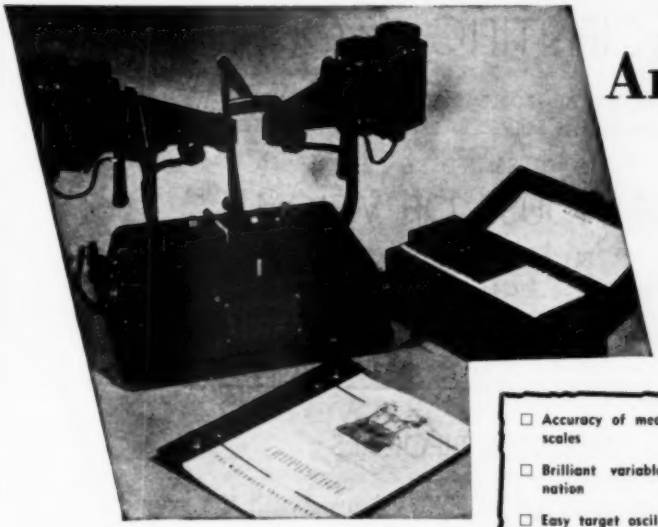

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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 32 MARCH, 1949 NUMBER 3

SUGGESTIONS FOR THE SURGICAL MANAGEMENT OF STRABISMUS*

THE FOURTH SANFORD R. GIFFORD MEMORIAL LECTURE†

LAWRENCE T. POST, M.D.
Saint Louis, Missouri

It was with great pleasure that I accepted the invitation of your society to deliver one of the annual Sanford R. Gifford lectures. "Sandy," as he was affectionately called, was a man whom I was proud to consider an intimate friend ever since we had struggled together at one of the early American Board of Ophthalmology examinations.

This opportunity to pay my small tribute to Dr. Gifford is one that I could not refuse and my sole regret is that this appreciation cannot be a more impressive one. Distinguished son of a distinguished father, Dr. Gifford made an enviable place for himself in the history of ophthalmology in America. It is hard to select his greatest contribution, but probably his textbook would be so considered as it was ideal in its field, broadly informative, accurate, and, above all, readable—a quality characteristic of all of his writing, one so eminently desirable and so seldom achieved.

He was an outstanding ophthalmologist, a charming, cultured gentleman, and a loyal friend.

When asked to present this talk, I recalled that the first Gifford lecture was by Dr. Francis Heed Adler on the etiology of strabismus. It occurred to me that a consideration of the practical side of the subject of strabismus might serve as a humble complement toward completion of the idea, although I must at once admit that this essay can cover only a few general suggestions on a big subject.

I. THE HISTORY

The most important etiologic factor is heredity. It occurs so frequently as to be the rule rather than the exception.

Another important historical factor is age of onset. In those patients in whom strabismus occurs early, roughly before the age of two years, there is almost always an anatomic basis and, in my experience, they are less prone to develop fusion postoperatively than those who develop strabismus later in life. This, I believe, is due to the fact that the children who develop strabismus later probably had already acquired some fusion before the deviation set in and the newly found fusion is merely a reëducation.

On the other hand, my associate, Dr. R. G. Scobee, has noted the acquisition of fusion in 8 of 10 infants with congenital strabismus who were operated on at the age of one year. He argues that given a mechanism permitting alignment of the eyes, fusion will usually develop and aid in holding the eyes straight.

He also believes that 90 percent of all strabismus appearing before the age of six years has an underlying anatomic basis, his point being that check ligaments, muscle slips, and abnormal insertions are found in 90 percent of the cases of strabismus (whereas they are never found in anatomic dissections of normal eyes) and that anatomic anomalies

* From the Department of Ophthalmology, Washington University School of Medicine, and the Oscar Johnson Institute. Presented before the Chicago Ophthalmological Society, January 26, 1948.

† This is a condensation of the lecture. Illustrations and illustrative cases have been omitted.

act as important underlying primary causes when associated with other etiologic factors.

II. The Examination and Procedure

1. A careful study is made of the fundi after full dilatation of the pupils. Abnormalities are noted and a gross estimate of the error of refraction is made. This dilatation is not for refraction but merely for the fundus examination. Atropine is used 3 times a day for 4 days before refraction.

2. Complete occlusion of the fixating eye is used to establish alternation. Elastoplast is a convenient material for this.

3. Glasses that contain full correction as measured under atropine are prescribed for constant wear. Too often ophthalmologists reduce this strength and thereby lose the advantage of full relaxation of accommodation and consequently the greatest relief of overconvergence.

4. As soon as coöperation permits, vision is taken with and without correction.

5. Near point of convergence is measured.

6. Angle Kappa is determined for each eye separately. The patient rests the chin in the cups on each side of the central standard, alternately, and fixates the central target on the perimeter with the fixing eye exactly over the finder. The reflection on the cornea of a flashlight moved along the arm of the perimeter is watched until it is exactly centered over the pupil, and the number of degrees of arc measured from the reflection of this flashlight to the center of the target equals the angle Kappa. If to the right for the right eye, it is plus, and if to the left, it is minus. Just the opposite pertains for the left eye.

7. Heterotropia is estimated by Hirschberg's method in infants. This method depends on the amount of displacement of the corneal image of a light, such as from a small bulb, on the cornea of a deviating eye while the patient fixates the light with the other eye. About 15 degrees of deviation may be estimated if the reflex lies at the pupillary margin of a 4-mm. pupil; if about half way between the pupillary margin and the limbus, the strabismus is about 30 degrees; if at the limbus, it is about 45 degrees.

8. Heterotropia is actually measured on the perimeter in children old enough to cooperate. The nose is placed in the midline of the perimeter and when the light from a flashlight moved along the perimeter arm is reflected on the exact center of the cornea of the deviating eye, the arc degrees are measured. Each eye is tested in turn; first, without glasses—with each eye fixing; then with glasses—with each eye fixing.

9. Heterotropia is also measured by screen and parallax.

10. Primary and secondary deviations are measured with prisms at this time. The patient is directed to fixate the light at 20 feet, first without correction and then with correction, with one eye and then with the other. Such prisms as are necessary to eliminate the movement when they are held before each eye in turn measure the primary and secondary deviations. In a similar manner tests are made at 13 inches. Ductions and versions are estimated and recorded on charts, but not measured in degrees, primarily to determine the vertical elements. Measurements in degrees in extreme positions of gaze have been found to be so variable that they have been discarded as more misleading than helpful.

III. Treatment

As early as possible, usually at about the age of 4½ years, orthoptics are instituted. An attempt is made to determine the nature of the correspondence and, if abnormal, to break it up and restore normal correspondence. Frequently orthoptics are impossible because of the remoteness of the patient's home, in which case, if the wearing of glasses, plus occlusion, does not accomplish straightening of the eyes, surgery is routinely recommended.

Although fusion is undoubtedly desirable because of some advantage of stereopsis in life, its greatest value is in preventing later

deviations which are much more prone to occur if fusion is absent.

It is fortunate that the majority of obvious muscle anomalies are in the horizontal field and since one general rule is to attempt to correct the principal defect first, the surgery of the horizontally acting muscles is usually the first to be done. This is the saving factor for many who do not analyze their cases carefully but correct only the horizontal deviation. They often get a good cosmetic effect. It is true also that vertical anomalies are less noticeable than horizontal.

It has been observed that the greater defect should receive first attention. It is important to remember that correction of the lateral deviation in cases in which there is also a vertical deviation may either increase or decrease the latter, depending on the muscles involved. For example, if a vertical rectus is involved, the deviation will be greater after correction of esotropia because returning the eyes to the primary position will bring them nearer the field of the maximum action of the vertical recti; whereas, if the difficulty is with an oblique, the effect of the correction of esotropic abnormality will be an apparent lessening of the strabismus caused by the abnormalities of an oblique muscle. Correction of an exotropia will act similarly but in a reverse manner.

If a cosmetic result is the surgeon's primary goal, a careful study of the angle Kappa is most important. The ratio of positive angle Kappa to negative angle Kappa is about 50 to 1. The average for each eye is about 5 degrees. Obviously a plus angle makes a convergent strabismus appear less than it actually is. Some people have such high plus angle Kappas that they actually appear to have an exotropia.

A surgical undercorrection in such a case will be compensated for cosmetically to whatever extent a plus angle Kappa may have been present before operation and, similarly, overcorrection is desirable for appearance sake, not for function, in cases of exotropia with a positive angle Kappa because the positive angle will make the exotropia appear greater than it actually is. However, it must be emphasized that this has no bearing on the development of fusion.

In choosing whether one eye or two are to be operated on in cases of lateral tropias, the following should be noted. Both eyes should be operated on if there is alternation, and a bilateral recession of the medial recti may be done if necessary if the near point of convergence is small; if larger than normal, more than 4 cm. from the bridge of the nose, and a secondary convergence palsy is present, not more than one medial rectus should be recessed. It is also true that other tests may indicate a contracture of a medial rectus as by abnormal check ligaments, muscle slips, or abnormal tendon insertions. These must be severed, as simply working on the medial recti tendons alone will be insufficient.

If the deviation is greater for near than for far in esotropia and esophoria, there is usually considered to be a convergence excess; but if greater for far than for near, a divergence weakness is presumed to exist. The near point of convergence is, however, a better gauge of the desirable surgery. In the former case, bilateral recession of the interni is usually indicated and, in the latter, a bilateral advancement or tuck of the lateral recti may theoretically be best, but it is seldom performed and the aforementioned considerations should weigh heavily in the decision as to the type of surgery. Any defective muscle must be investigated for possible abnormal check ligaments or other restricting abnormalities.

To be borne in mind is the help furnished by hypermetropia in combatting an overcorrection of esotropia. For example, presuming a high hypermetropia and a surgical overcorrection of a convergent strabismus, it is often possible to get a good result, including fusion, by prescribing an undercorrection of the hypermetropia, thus stimulating convergence.

Similarly, full correction, or even a little

overcorrection, will often compensate for surgical undercorrection.

In like manner, in cases of exotropia or exophoria, if the deviation is greater for near than for far, the condition is supposed to be a convergence weakness and, if greater for far than for near, it is supposed to be divergence excess. In the former case, resection of one medial rectus and recession of the lateral rectus in the same eye or a bilateral resection of the medial recti may be done and, in the case of divergence excess, bilateral recession of the lateral recti is to be done.

All of the factors mentioned and others also must be evaluated to determine the best remedial surgery in the given case. To reiterate, of the above considerations the near point of convergence is probably the most important.

Several consoling facts in the surgery of strabismus may be mentioned. Parents do not often demand a perfect result, being satisfied with a good postoperative appearance. Fusion and its value, unless stressed by the surgeon, mean little to them or to the child. Lastly, third-degree fusion is often obtainable without an exact correction of the deviation, since the innate fusion desire, plus fusion training, may bring this about.

The technique of the surgery is not considered of as great importance by me as is the diagnosis that indicates what should be done surgically, provided that: (1) the muscles are so sutured that they will be well spread out in their new positions and will not slip, (2) anatomic anomalies and check ligaments, when found, are cut, and (3) muscle sheaths are not unnecessarily removed.

It must be understood that I do not think that it is always possible to determine just what surgical procedure will be best until the patient is under anesthesia and the muscles inspected. Observation under anesthetic should then include (1) noting the difference in the amount of the deviation at that time from that before operation, (2) the action of the eye when pressure is made in the canthus opposite that of the deviation, (3) the condition as regards check ligaments and intermuscular septa and insertions, and (4) the elasticity of the severed muscles in order to determine the extent of the surgery to be done on each.

IV. Surgical technique

My technique for both recessions and resections is as follows: The tendon of the muscle to be recessed is exposed by a 10-mm. curved incision over the tendon insertion. Tenon's capsule is lifted at the upper or lower border of the muscle and snipped. A muscle hook is introduced under the tendon and brought out at the opposite border after another snip is made in the capsule at the point of exit of the hook.

The muscle is secured by one arm of a double-armed, 3-0, plain catgut suture introduced at the junction of the upper and middle thirds of the tendon and carried through the middle thickness of the tendon to the border and then looped behind the muscle to its center, the needle being brought out proximal to the suture and passed through the loop of the suture and drawn taut.

The other half of the double-armed suture is introduced similarly through the lower third of the tendon. The tendon is cut very close to its insertion. It is then held away from the globe, and the conjunctiva and all check ligaments and abnormal bands between the recti are cut with sharp scissors until the muscle retracts freely into the orbit, care being taken not to strip the muscle sheath away from the muscle. It is then secured by suturing the two free ends of the tendon to the globe at the desired points at least 5 mm. apart. A surgical knot is used so that there will be no slipping as the knot is tightened.

Closure of the conjunctiva is with the remnants of the catgut. Three sutures are used. These are later absorbed or fall out. This is much simpler than the removal of nonabsorbable sutures in intractable children.

Resection is performed in a similar

manner. The suture is placed in the tendon at the desired distance from the insertion, and the free end of the tendon between the suture and the insertion is excised. It is wise not to cut the lateral and other attachments.

One point is of utmost importance and, although often mentioned, is not sufficiently observed. It is the cutting of check ligaments. These bands extending to the orbital wall, especially large and prominent from the medial recti, if not carefully severed will usually nullify the effect of surgery on these muscles. The usual illustrations suggest that they are single sheets, but actually they almost never occur singly but more often radiate from the muscle sheath in fan-shaped planes.

Abnormal muscle slips, especially between the recti, must also be looked for and, if found, must be severed for a like reason. The surgeon should be sure that the muscle will retract freely into the orbit after it has been cut from its insertion and that no check ligaments remain. For a comprehensive discussion of the importance and handling of these ligaments, I would refer you to a recent paper by Dr. R. G. Scobee,[1] who has also pointed out the value of making pressure in each canthus to determine the binding effect of each rectus. If firm adhesions or constrictions exist, the eye will be pushed back and will not turn freely. This may be an important guide to surgery.

Another point, previously mentioned, is whether or not under anesthesia the contracted muscles relax and the eyes appear straighter than before anesthesia. If they do, there are less apt to be strong contractures. In those cases in which the eye rotates readily upon pressure of the strabismus hook or the convergence is much less under anesthesia, the strabismus is probably on an innervational basis and surgery, especially advancement, must be most conservative or an overcorrection may result.

In cases of alternating convergent squint, if the patient uses his right eye when looking left and his left eye when looking right, there is usually no overactivity of the medial recti and the convergence near point may even be remote. The general rule that only one medial rectus should be recessed in such cases must be followed or a divergence may result. On the other hand, if a convergent alternator uses the right eye when looking right and the left eye on looking left, abduction is usually good and the medial recti are habitually overacting and bilateral recessions of these muscles can be done safely.

I concur in Payne's[2] recommendation that a patient with what appears to be paralysis of a lateral rectus should have a full resection of the apparently paralysed muscle and a recession of the antagonist rather than a Hümmelsheim operation as the first procedure because often such surgery will show that the muscle was not truly paralyzed, and the more elaborate operation of splitting the superior and inferior recti and utilizing their halves to aid the nonacting muscle may prove unnecessary.

Surgery of the obliques is occasionally indicated. The question then arises whether the weak oblique should be advanced, as has been done very successfully by McLean and others, or the yoke muscle weakened. This latter has been the method I have used, but such good results are claimed for working on the weaker muscle that I am not convinced that my method is the better procedure.

A point to be made is that the section of the inferior oblique should be made near its insertion and not, as often recommended, at its origin. The reason for this is that there is much variation in the insertion and that the suspensory ligament of Lockwood acts as a secondary origin and, since this is distal to the part sectioned in tenotomy near the origin, there is often very little accomplished by the operation.

Fink[3] has brilliantly pointed out numerous variations in the insertions of the inferior oblique. The insertion can be exposed without sectioning the lateral rectus, which is pulled upward by an assistant who reaches outward below the tendon of the lateral rectus and hooks the tendon of the inferior

oblique upward and medially before it is severed.

The superior oblique may be reached either by sectioning the superior rectus and hooking the superior oblique downward, opening its sheath horizontally and cutting the tendon in its sheath, or, as Berke[4] has advocated, without cutting the superior rectus tendon. If more effect is desired, a few millimeters of the tendon can be resected. I have found that sectioning of the superior rectus makes the operation much simpler.

The problem of exophoria-exotropia is a constantly recurring one. Exercises sometimes develop good fusion and comfort when discomfort has been noted. The tendency, however, as time goes by, is toward increasing divergence and finally results in failure of fusion from disuse. Surgical correction is simple and usually effective. Principles already outlined should govern the type of surgery. I have had consistent success with this procedure.

Conclusion

There should be a thoughtful and complete study of each case of strabismus before surgery and the role of the vertical recti in producing the defect should be carefully analyzed and a two-stage operation performed in cases in which both lateral and vertical deviations occur.

640 South Kingshighway (10).

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Ophthalmic Miniature

Like cloudy vapours,
these the Eyes o're cast,
Yet vanished as the dew,
by sunne at last:

Long practice, careful skill,
with observation,
Will teach the mystery
of the operation,
To end this worke,
that perfect it may stand,
God guide with carefull skill
our Eye, our Heart and hand.

Richard Banister, Mr. In Chyrurgery,
Oculist and Practitioner in Physicke.

BETA IRRADIATION OF THE EYE*

WILLIAM F. HUGHES, JR., M.D.
Chicago, Illinois
AND
CHARLES E. ILIFF, M.D.
Baltimore, Maryland

Recent reports and discussion of the value and dangers of irradiation of the eye with the beta rays of radon have been both enthusiastic and pessimistic.[1-4] The present uncertainty can be attributed to many factors, among which may be mentioned: (1) Variability in dosage and technique of application, with too little attention being paid to the characteristics of the irradiation used, the distance of the applicator from the eye, localization of the area to be treated, and possible cumulative effects; (2) ignorance of the differential sensitivity of the normal tissues of the eye and those tissues which are to be destroyed by irradiation; and (3) difficulty in comparing the results of beta treatment with untreated controls. Often the beta irradiation clinic becomes a convenient spot to which hopeless cases can be referred regardless of theoretical or practical justification.

In this paper, the various techniques and effects of beta irradiation will be discussed in an effort to arrive at a selection of suitable cases for treatment, and to utilize a dose sufficiently large to destroy undesirable tissue without undue damage to the normal structures of the eye. In addition, we will report some preliminary experiments on the use of beta irradiation following chemical burns of the eye, especially in regard to vascularization of the cornea.

TECHNIQUES FOR THE USE OF BETA IRRADIATION

The Burnam applicator, which contains a concentrated source of radon in a single glass bulb, has been described previously.[1, 5] The alpha particles or helium nuclei are completely absorbed by the soda glass bulb containing the radon. The beta particles or electrons are directed through a 4-mm. opening at the end of a brass tube of walls 2 mm. in thickness. The gamma rays, comparable to hard X rays, are emitted simultaneously with the beta particles but only in comparatively low concentration. According to Failla and others,[6] radon emits 96.5-percent beta and 3.5-percent gamma in terms of electrostatic units of ionization.

From a bulb such as the Burnam applicator, the center of which is 2.5 mm. from the tissue, 75.2 percent of the irradiation is absorbed within the first millimeter of tissue, 93.7 percent within the first 2 mm., 96.1 percent within the first 3 mm., and 98.9 percent within the first 5 mm.

The ratio of beta to gamma varies at different tissue depths as follows: at 1 mm. = 88-percent beta; at 2 mm. = 78.5-percent beta; at 3 mm. = 67.6-percent beta; at 4 mm. = 55.5-percent beta; and at 5 mm. = 43-percent beta. Therefore, it is possible to give therapeutically useful doses of beta without significant gamma irradiation which might damage the lens or deeper structures of the eye.

Because of the unavailability of radon in many localities, a radium applicator for ocular use has recently been described.[7] Although the applicator contains 50 mg. of radium, the effective output of beta particles is only about 30 mc. Such a relatively low output necessitates prolonged treatment times, and because of this a mechanical holder is desirable.

This applicator is apparently satisfactory for most conditions, but the source is not

* From the University of Illinois College of Medicine and the Wilmer Ophthalmological Institute of The Johns Hopkins Hospital and University. A summary of this paper was presented before the Chicago Ophthalmological Society, February 16, 1948.

sufficiently localized and concentrated for use in the obliteration of corneal vascularization. Also, the safety ratio between the output of beta and gamma is reduced by almost half. This type of criticism can be applied to many sources of beta radiation in which the mass itself filters out a significant number of the beta particles.

Dosage

One gram of radium is equivalent to one curie or 1,000 mc. of radon, a gaseous emanation of radium which emits radiations identical to those of radium. The dose of beta particles is dependent on the amount of radon and the duration of treatment, and can be calculated as follows:

$$\text{No. secs. exposure} = \frac{\text{No. gram secs. desired} \times 1{,}000}{\text{No. millicuries of radon}}$$

(or)

$$\text{No. mins. exposure} = \frac{\text{No. millicurie minutes desired}}{\text{No. millicuries of radon}}$$

For conversion:

No. gm. secs. $\times$ 16.66 = No. millicurie mins.
No. gm. secs. $\times$ 0.278 = No. millicurie hrs.

The intensity of irradiation varies inversely with the square of the distance of the applicator from the target. Therefore, a slight variation in distance results in a large difference of effective dose. In addition, with the so-called "spray technique" in which the applicator is held from 1 to 3 mm. above the tissue and is moved slightly back and forth, there is an uneven and uncertain distribution of the total dose over a poorly defined area.

For these reasons during the past two years treatments have been given by placing the applicator in contact with the lesion. The dosage for such contact therapy varies between 3 and 5 gram seconds per treatment. Ordinarily, treatments are not administered more frequently than every two weeks to the same area in order to avoid cumulative effects. In all initial treatments, and especially in children, even smaller doses should be given to avoid undue reactions in hypersensitive individuals. The rabbit eye is more resistant to the effects of beta particles than the human eye, tolerating approximately three times the dose for human beings.[8, 9]

The action of irradiation on tissues

Irradiation has no effect on tissues unless it is absorbed. In addition, the intensity of the effect is directly related to the amount of effective quantum energy, an inverse function of the wave length, at the site of absorption. It is generally agreed[9-12] that the biologic actions of various types of irradiation on the individual cell and supporting structure are similar. When the beta particles or high speed electrons strike a cell, changes are produced in both the cytoplasm and nucleus associated with ionization of the tissue. Large doses cause immediate death of the cell, perhaps by mechanical rupture of the structural portions of the cell and chromosomes. This is particularly true of beta irradiation in which 75 percent of the dose is absorbed within the first millimeter of tissue, producing a more concentrated number of "hits" and ionization than with X ray or gamma rays, which are absorbed more diffusely and deeply in the tissues.

Following smaller doses of irradiation, histologic changes are well demonstrated in the corneal epithelium.[8, 13] A few hours following a small dose of ultraviolet or beta irradiation, normal mitotic figures disappear from the basal layers of the epithelium. With somewhat larger doses, a small proportion of cells develop nuclear fragmentation, the chromatin material sometimes assuming the configuration of abnormal mitoses.

In agreement with experiments using other types of irradiation, the resting cell seems to be relatively resistant to damage. However, the cells which later develop abnormal mitoses and nuclear fragmentation are probably in a specially sensitive state at the time of exposure; namely, a premitotic or very early stage of prophase.[11] This may explain why rapidly proliferating tissues are

especially sensitive to irradiation—embryonic tissue, the tissues of young growing children, germinal epithelium, and certain neoplasms.

As will be pointed out later, rapidly proliferating endothelium of capillaries growing into the cornea can be inhibited by a smaller dose of beta than that required to obliterate an already formed vessel. In order to catch as many cells as possible in the sensitive premitotic stage, most radiotherapists use repeated small doses to destroy undesirable proliferating tissue, thereby reducing the amount of damage to less sensitive normal tissue.

Clinically, nuclear fragmentation in the corneal epithelium produces a superficial punctate erosion stainable with fluorescein. Larger doses of beta irradiation readily cause necrosis and disappearance of corneal stromal cells, thus emphasizing the need for caution in radiation treatment of any condition directly over the cornea, especially if there has been some loss of stromal cells previously from the disease process (recent chemical burn, corneal ulcer, and so forth).

Irradiation also causes a swelling of collagen,[10] one of the important structural components of the corneal stroma. Since a significant proportion of beta does not penetrate deeper than the cornea or sclera, doses sufficiently large to cause the perforation of a rabbit's cornea can be given without the development of cataract. A few rabbit eyes received 12 gram seconds of radon every 2 weeks for 8 months without the development of cataracts.[8] Clinically, we have not seen any radiation cataracts from radon treatment over the course of 10 years, and this experience is corroborated by Ruedemann.[2]

In agreement with almost all radiologists, we have found no evidence of stimulating action following irradiation. In fact, all regenerative processes seem to be retarded following the use of beta; namely, regeneration of the corneal epithelium, proliferation of new stromal cells, and vascularization of the cornea.[8]

The well-known cumulative effects of radiation apply to beta radiation of the eye. The interval during which a second application of beta is additive to a previous dose varies directly with the size of the dose. In general, however, cumulative effects are obtained if two therapeutic doses are given within a period of two weeks.

Radiosensitivity

Since the principle underlying all radiotherapy consists of a differential sensitivity of the diseased tissue to be destroyed and the normal surrounding structure, the relative radiosensitivity of various cells becomes important.

Desjardins[14] listed these in order of diminishing sensitivity as follows: lymphoid cells, polymorphonuclear and eosinophilic leukocytes, epithelium, endothelium, connective tissue, muscle, bone, and nerve.

Other factors which increase radiosensitivity are as follows:[9] undifferentiation and immaturity of the cell, state of activity (premitotic), active metabolism (related both to oxygen consumption and growth), and increased blood supply (in inflammatory conditions).

Effects of beta irradiation treatment of conditions involving the globe

The dramatic responses of certain bulbar conditions to the application of beta irradiation have been described elsewhere[1, 2] and will not be repeated here except to point out the reasons for the outstanding successes and possible explanations for the failures.

Vernal conjunctivitis

The excellent therapeutic response following the use of beta irradiation in both palpebral and limbal forms of vernal conjunctivitis has been amply demonstrated by many clinicians. In early cases, the papillae consist of lymphoid cells, young fibroblasts, and blood vessels, and these elements are very radiosensitive. However, old "pavement-stone" vegetations which contain areas of hyaline degeneration and old fibrous tissue are more resistant. Successful radiotherapy

of vernal conjunctivitis also reduces the number of recurrences.

Papillomas

Papillomas of the lids, conjunctiva, and limbus usually respond dramatically to beta irradiation. Since an intraepithelial epithelioma of the limbus spreads superficially over the cornea, this neoplasm can be destroyed by beta irradiation without damage to the underlying normal corneal stroma. Of course, beta cannot be used for any tumor which extends into the eye or orbit because of its lack of penetration.

Angiomas

Except for the nevus flammeus or port-wine stain, angiomas of the lids, conjunctiva, and caruncle are very radiosensitive.

Vascularization of the cornea

The possible importance of the ingrowth of blood vessels into the cornea to relieve anoxemia or remove toxic inflammatory products cannot be evaluated at present. However, several undesirable features of corneal vascularization may be listed.

1. Reduction in the transparency of the cornea. "Shadow vessels" ordinarily cause little reduction in vision. However, Spicer has described a late secondary opacification around such vessels giving the appearance of "lines of clearing" and resulting in a significant decrease of visual acuity.

2. Following extensive injuries of the corneal stroma including the limbus, there is a pronounced tendency toward the ingrowth of blood vessels, accompanied by a pterygiumlike tissue over the surface of the cornea. A nodule of granulation tissue may form on the cornea, persisting as a thick scarred cornea of uneven surface.

3. Many heavily scarred and vascularized corneas remain chronically irritated, edematous, and show evidence of retarded healing.[18]

4. A heavily vascularized cornea makes a poor candidate for later keratoplasty.

Beta irradiation has been used clinically to prevent or more often to obliterate corneal vascularization. To determine the most effective technique for this purpose, we have applied beta to the vascularization of rabbit corneas which followed intracorneal injection of sodium hydroxide.

Technique of experiments

Corneal vascularization was induced by the intracorneal injection of 0.05 cc. or 0.1 cc. of N/20 sodium hydroxide. The most marked and consistent vascularization was produced when the opaque area of injection touched the limbus. When the injected area was located centrally and was surrounded by a zone of clear cornea, vascularization was minimal.

On the other hand, extravasation of the sodium hydroxide into the region of the limbal vessels resulted in ischemic necrosis of this region, and subsequent vascularization of the cornea usually arose from the intact limbal vessels at the edge of the lesion. The severity of the important corneal symptoms was graded numerically according to the following scale of maximal values:

Corneal Opacity: intensity plus 4 × area in millimeters = total grade.
Corneal Vascularization: millimeters of limbal circumference from which vessels enter cornea × millimeters of distance the vessels enter the cornea.

Comparison of treated and untreated areas was made either between two separated areas in the same cornea (0.05 cc. of N/20 sodium hydroxide injected in each area), or more often between two eyes of the same animal (0.1 cc. of N/20 sodium hydroxide injected in each eye).

Since it was technically impossible in most instances to produce two exactly similar lesions for comparison, some allowance was made in Table 1 for the fact that the most severe opacity was usually treated. This was done as follows: (a) the initial reading of the corneal opacity to be treated was given a plus value and the control area a negative value; (b) the final reading of the treated

cornea was given a negative value and the control area a positive value; and (c) a final value to determine any possible effect of treatment was obtained by taking the algebraic sum of the original difference and final difference between the treated and control areas. A plus value would therefore suggest a beneficial effect of treatment and a minus value a detrimental effect.

vessels, as illustrated in Figure 1. However, because the area covered by the applicator was only 4 mm. in many of the eyes treated in this manner, large trunk vessels would pass between the sites of treatment and enter the cornea, thence fanning out and thoroughly vascularizing the entire burned area.

Efforts were made to obliterate already

TABLE 1

TREATMENT OF ALKALI BURNS WITH BETA DIRECTLY OVER LESION

Experiment Number	Beta Rx No. Gram Secs. (Day of Rx)	Total Dose of Beta (Gram Secs.)	Difference in Treated and Untreated Areas						No. Days Followed
			Original Reading		Final Reading		Total Difference or Improvement		
			Corneal Opacity	Pannus	Corneal Opacity	Pannus	Corneal Opacity	Pannus	
1	24(0) +24(7) +12(35) +12(49)	72	+6	− 9	− 3	−30	+ 3	−39	189
2	24(0) +18(35) +18(49)	60	+5	−14	−10	−10	− 5	−24	189
3	24(0) +12(35) +12(49)	48	+4	−11	− 4	−10	0	−21	189
4	24(0) +18(35)	42	+9	− 6	−19	−10	−10	−16	74
5	12(0) +12(7) +12(35) +12(49)	48	0	−16	+ 5	− 8	+ 5	−24	189
6	12(0) +18(35) +18(49)	48	+7	+ 7	+ 2	−30	+ 9	−23	189
7	12(0) +18(35) +18(49)	48	−3	−13	− 3	−15	0	−28	189
8	24(7)	24	−8	0	+10	+36	+ 2	+36	16
9	24(7)	24	+7	+ 2	−10	− 3	− 3	− 1	16
10	24(7) +18(35) +18(49)	60	0	+ 2	− 4	0	− 4	+ 2	74
11	24(7) +12(35) +12(49)	48	+2	+ 4	0	−40	+ 2	−40	74
12	R.E. 12(0) +12(7) +12(35) +12(49)	48	0	− 4	+ 3	0	+ 3	− 4	74
	L.E. 18(35) +18(49) (Eyes looked the same on 35th day)	36							

Eyes Nos. 1, 2, 3, 4, 8, 9, 10, 11 received two areas of injection in each cornea of 0.05 cc. of N/20 NaOH each. Two areas compared in a single eye.
Rabbits Nos. 5, 6, 7, 12 received a single injection of 0.1 cc. of N/20 NaOH in each cornea. Two eyes compared.
Burnam applicator and Lucite contact glass used (8), the glass bulb containing radon being 6 mm. above the area treated.

Results

1. Treatment over lesion (table 1). Application of varying doses of beta at varying intervals directly over the area of corneal involvement had little effect on the ultimate corneal opacity, but, if anything, made the pannus more intense.

2. Contact therapy without lucite holder. In 21 eyes, the Burnam applicator without lucite holder was placed in direct contact with the limbus adjacent to the area injected 24 hours previously. An average number of 4 applications at one sitting was performed, the dose for each site ranging from 6 gram seconds to 24 gram seconds. This single treatment with beta had little effect on the corneal opacity. A dose of 12 gram seconds was sufficient to inhibit the ingrowth of formed vessels by direct application of the Burnam applicator at the source of the vessels at the limbus. A dose of 6 gram seconds was insufficient to obliterate even superficial loops of vessels, 12 gram seconds effectively obliterated superficial vessels of moderate size, and 18 gram seconds occluded deeper vessels. Doses of 18 to 24 gram seconds also seemed to cause some additional necrosis of the already injured corneoscleral tissue, a few eyes developing perforations at the site of heavy treatment and chemical necrosis. Mulberrylike elevations of granulation tissue on the surface of the cornea could be reduced by 12 gram seconds applied directly over the area. However, the obliteration of large trunk vessels by beta could only be accomplished at the expense of excessive

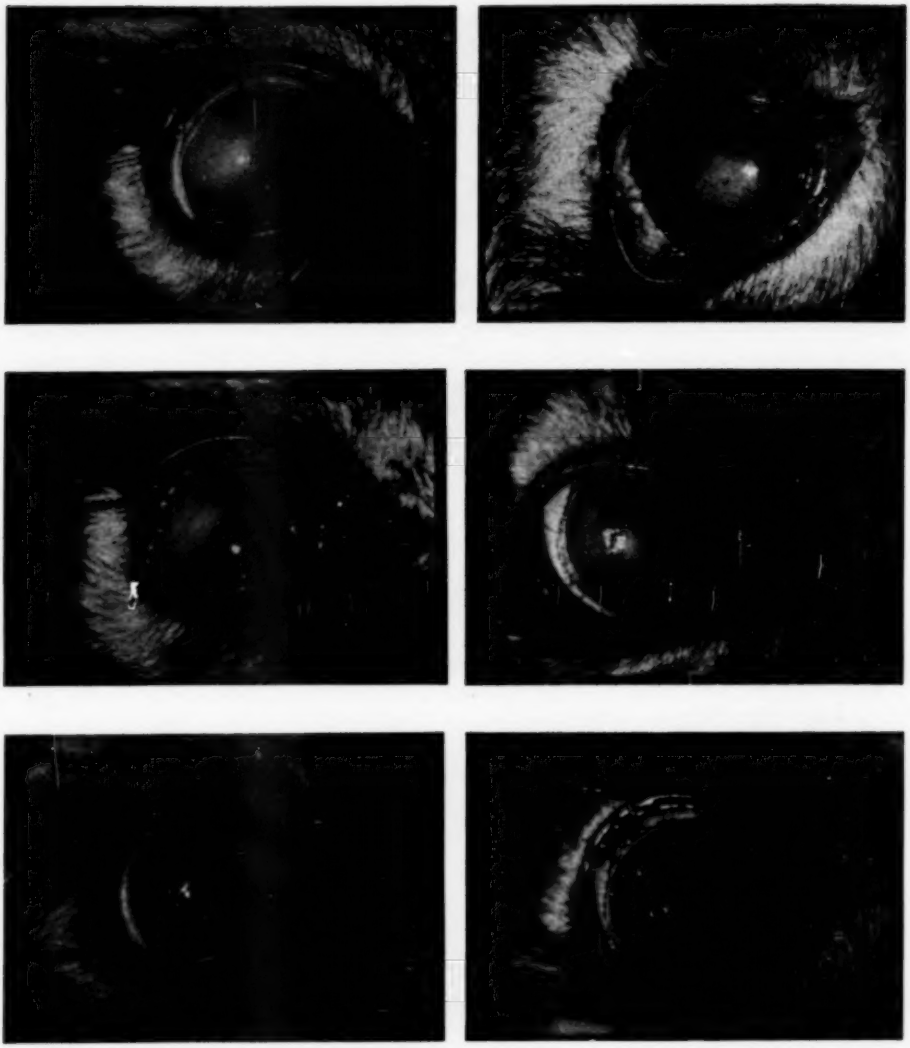

Fig. 1 (Hughes and Iliff). *Right eye* (pictures on left). Intracorneal injection of 0.1 cc. of N/20 sodium hydroxide treated one day later with 12 gram seconds of beta irradiation at each of three sites on the limbus adjacent to the involved area. Photographs (top to bottom) at 15 days, 21 days, and 29 days after injection. *Left eye* (pictures on right). Untreated control. Photographs (top to bottom) at 15 days, 21 days, and 29 days after injection.

scleral necrosis, and could have been more easily accomplished by means of electrolysis or cautery.

3. Spray therapy at limbus with lucite holder (table 2). Because of the great tendency for vessels to slip between and around the sites of beta application, a lucite holder was used in the following series of experiments in order to provide a wider area of exposure (11 mm.) and some overlapping.

The radon bulb was held 6 mm. above the tissue with this holder. In this small series

of experiments, little significant effect of beta on the residual corneal opacity and pannus could be detected after "spray therapy" over the limbus. However, the maximal intensity of pannus was significantly lower in 7 eyes which received an application of 75 gram seconds over two limbal areas 24 hours after the injection of sodium hydroxide.

Several striking results were seen repeatedly following the use of beta in these experiments: (a) A dose of 6 gram seconds held 6 mm. over the limbus prevented the ingrowth of superficial but not of deep vessels, and 12 gram seconds largely prevented deep vascularization of the cornea. (b) Normal limbal vessels were unaffected by doses of 12 gram seconds, although 24 gram seconds produced ischemia and edema. (c) With single small doses insufficient to prevent corneal vascularization indefinitely, a delay of from 2 to 3 weeks in vascularization was noted. (d) Budding loops of vessels growing into the cornea could be stopped at any point by beta, the ends of the vessels becoming bulbous, tortuous, and associated with small blood lakes.

4. Effect of dry ice on corneal vascularization. The application of dry ice to tissue is a good method of producing cellular destruction without much structural alteration. As a control for the beta experiments previously described, dry ice was applied for 15 seconds to the sclera adjacent to the area of corneal opacification produced by the injection of 0.1 cc. of N/20 sodium hydroxide two days previously. In 5 rabbits followed for 52 days, the treated eyes showed an average maximum pannus of 36 compared with a grade of 26 for the untreated eyes, and the average residual vascularization after 52 days was 9 points worse in the treated eyes. No effect was noted on the intensity of the corneal opacification. The effect of beta, therefore, either has a more specific effect on the proliferation of capillary endothelium, or a more prolonged action.

TABLE 2

TREATMENT OF ALKALI BURNS WITH BETA APPLIED OVER LIMBUS

Dose for Each Area (Gram Secs.)	No. Areas Treated	Day of Treatment	No. Rabbits	Difference in Treated and Untreated Eyes				No. Days
				Original Reading Corneal Opacity	Max. Pannus	Final Reading Corneal Opacity	Pannus	
6	4–5	1	4	+4	−72	−19	−31 Deep Vessels	48
12	3–6	1	5	+3	− 6	−10	−16	59
12	6	4	1	0	0	+11	−15	106
12	3, 5	8	2	+1	+ 4	− 4	−15	114
25	3	1	2	+1	−60	−12	−42	79
25	2	8	1	+2	+ 6	0	− 7	44
75	2	1	7	+2	+27*	+ 2	+ 8	52

* Standard error of differences = 6.4.

Summary

With rabbit corneas previously exposed to sodium hydroxide, the use of beta irradiation was most effective in the reduction of granulation tissue masses on the surface of the cornea and in the obliteration of small superficial blood vessels crossing the limbus.

Vascularization of the cornea could be prevented by the alert and judicious use of beta, the best results being obtained by covering a relatively wide area of the limbal sclera adjacent to and slightly beyond the limits of the cornea involved by the chemical

burn. The inhibitory effects of the irradiation lasted from 2 to 3 weeks. The relatively small doses of beta required to prevent the ingrowth of vessels must inhibit the proliferation of capillary endothelium, because clinical and histologic examination revealed no thrombosis of the vessels.

Once the vessels had become established in the cornea, larger doses of beta were required over the limbus to obliterate the vessels. Large trunk vessels were difficult to obliterate by beta treatment, and direct cauterization, electrolysis, or the use of diathermy current as advocated by Gundersen[15] would have been preferable.

As mentioned previously, not more than one third of the dose necessary for rabbits need be used for human eyes in whom a dose of 5 gram seconds contact therapy with the Burnam applicator over the sclera is sufficient to obliterate vessels.

The following clinical conditions associated with corneal vascularization have been treated with irradiation, the results of which have been reported favorable: (1) In conjunction with superficial keratectomy to prevent the revascularization of the cornea; (2) before and after keratoplasty in cases with heavily vascularized corneas; (3) chemical burns such as sulfur dioxide; (4) acne rosacea keratitis and other vascularizing keratitis of unknown etiology.

Pterygium

Beta irradiation has been employed as a primary treatment for pterygium.[2] It is particularly useful in those cases of "malignant" pterygia which recur after surgical transplantation and are associated with marked vascularization.

Infections

The effects of roentgen irradiation in the treatment of inflammations have been reviewed well by Pendergrass and Hodes.[16] It is generally agreed that doses tolerated by the tissues are not bactericidal. Large doses apparently depress the defense mechanisms of the body, especially the reticuloendothelial system, and the most effective results are obtained by using no more than one fourth to one third of a skin erythema dose.

The reasons for the beneficial effects of small doses of X ray on acute inflammations are uncertain, but have been attributed to a destruction of leukocytes with liberation of proteolytic enzymes and antibodies,[17, 18, 19] liberation of antibodies from other sources, and the production of an active hyperemia.[16]

Chronic infectious granulomas, such as tuberculosis, respond favorably to somewhat higher doses of X ray, probably because of the radiosensitivity of epithelioid and giant cells which are replaced by fibrous tissue,[9] and perhaps because of the liberation of antibodies.

The relatively few attempts to treat pyogenic corneal ulcers with beta irradiation have been unsuccessful,[1] in some instances leading to perforation of the cornea. It may be that the concentrated character of this type of irradiation is unsuitable for acute infectious processes, that the dosage employed was too large, or that a beneficial hyperemia is impossible in the avascular cornea.

On the other hand, Woods[20] and Iliff[1] have reported that of 72 eyes with anterior ocular tuberculosis treated with beta irradiation, 52.8 percent were healed for at least one year, 38.9 percent were improved, and 8.3 percent were unimproved. Improvement in visual acuity of at least two lines occurred in 42 percent, vision was maintained at the same level in 46 percent, and decreased in 12 percent. No effect on recurrences of the attacks was noted. Because of the wide variation in the characteristics and ultimate prognosis of anterior ocular tuberculosis, statistical certainty that beta irradiation has been of value in this condition is impossible.

A few cases of ocular sarcoid have not responded favorably to beta treatment. Iliff[1] reported one case of blastomycosis of the outer canthus treated successfully with beta. Cases of pemphigus and lupus erythematosis have not responded.

Corneal scars

The ultimate clarity of the cornea following a condition which involves the stroma cannot be estimated accurately because of normal recovery powers including absorption of inflammatory exudate, subsidence of edema, disappearance of blood vessels, and regeneration of the corneal corpuscles. Such reduction in the size and intensity of the opacification is especially prominent in children, and the cornea may continue to become clearer for several years. For this reason, any results obtained in the treatment of corneal scars with irradiation should be interpreted cautiously. Although fibroblasts are sensitive to irradiation, fibrocytes in old scar tissue are not.

Relative to this problem, the corneal lesion in one eye of each of 9 rabbits which had received an intracorneal injection of 0.1 cc. of N/20 sodium hydroxide was treated with 6 gram seconds every two weeks for 18 weeks, beginning 7 days after the injection. This dose was previously found to be the maximally tolerated dose for a normal rabbit cornea. After 198 days, there was no significant difference between treated and untreated eyes (table 3).

A second experiment consisted of 5 rabbits with old sodium hydroxide scars, and the use of beta was without beneficial effect on these eyes (table 3).

Clinically also, beta irradiation was found to have no effect on old corneal scars of various types.[1] Doses sufficiently large to destroy old fibrous tissue destroy normal stromal cells and in fact retard normal regenerative processes. It is difficult to see how the use of beta on scarred corneas could have anything but a detrimental effect since there is no known stimulating effect of any type of irradiation on the proliferation or growth of cells. It is possible that irradiation during the stage of active proliferation of fibroblasts may diminish the ultimate amount of scarring, but it may be undesirable to inhibit such repair of a recently damaged cornea because of the danger of perforation.

TABLE 3

TREATMENT OF CORNEAL SCARS FOLLOWING SODIUM HYDROXIDE BURNS WITH BETA IRRADIATION

Dosage*	No. Rabbits	Average Difference between Treated and Untreated Eyes†		Days Followed
		Corneal Opacity	Pannus	
6 gram seconds on 7th day after NaOH injection and every 2 weeks for 18 weeks.	9	+1	−2	198
6 gram seconds every 2 weeks for 12 weeks beginning 71 days after NaOH injection.	5	−8	+4	170

* Using Burnam applicator and Lucite holder, radon 6 mm. above cornea.
† Plus value = treated eye improved over untreated eye.

Conclusion

Beta particles of radon represent a concentrated source of irradiation which is largely absorbed within the first 2 mm. of tissue and is therefore useful in the treatment of superficial conditions of the lid, the conjunctiva, cornea, and sclera. The effective use of beta irradiation in ophthalmology depends upon an exact knowledge of the differential between the sensitivity of normal tissues and the pathologic tissues to be destroyed.

In general, lymphoid tissues (the follicles in vernal conjunctivitis), epithelial growths (papillomas), and vascular endothelium (in corneal vascularization) form the most sensitive tissues which can be destroyed by

beta irradiation without undue injury to the normal ocular structures.

Because of the great sensitivity of the corneal epithelium and stroma cells, direct irradiation over the cornea should be used with caution.

Corneal vascularization is best obliterated by irradiation over the scleral portion of the limbus.

An ocular condition associated with great cellular destruction or pyogenic infection may respond poorly to beta irradiation.

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The Johns Hopkins Hospital (5).

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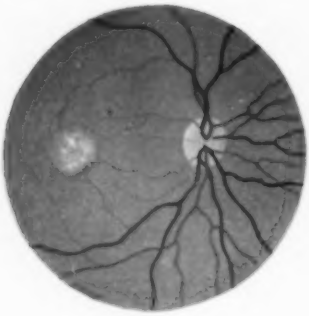
FIG. 1



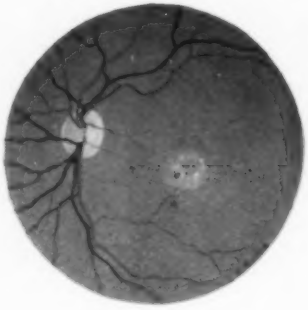
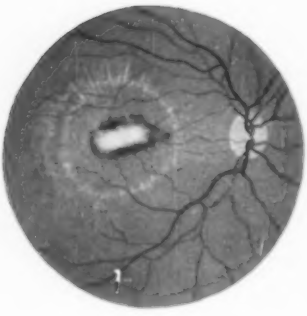


FIG. 2

FIG. 3



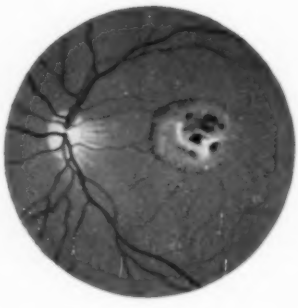
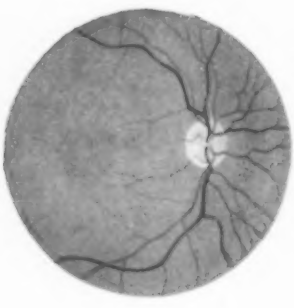


FIG. 4

FIG. 5



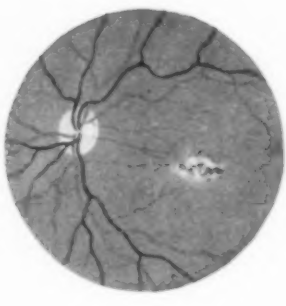
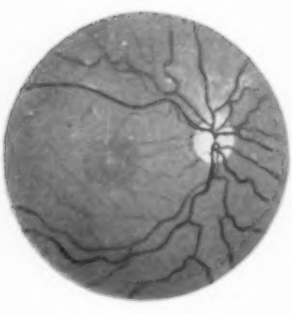


FIG. 6

FIG. 7



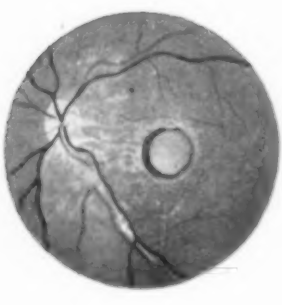


FIG. 8

HEREDODEGENERATION OF THE MACULA

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Degenerations of the macula appear in the literature under a host of disease entities. Closer observation reveals many of these so-called entities are closely allied, if not actually identical. The confusion, which is apparent after reviewing the literature, is partially justified because of the absence of a pathologic study in the great majority of these central lesions. Thus, classifications have been based on history, funduscopic findings, and personal interpretations.

Behr,[1] in 1920, made a noteworthy attempt to clarify the situation by suggesting that a number of macular degenerations of familial and hereditary incidence be placed in one great group which he elected to call heredodegeneration of the macula. Since then there have been numerous additions to the literature of such cases. Lloyd[2] further suggested the need of "streamlining" the nomenclature of these macular lesions. The more recent texts, as Elwyn's,[3] are agreed that a condensation of the classification is preferable to the individual listing of a plethora of closely allied conditions.

This report does not purport to offer a new classification nor to suggest a modification of an older one. It is hoped simply that the presentation of another family group showing macular degeneration with some interesting associated findings (red hair and color blindness) will prove of some value toward the final understanding of this disease. Chart 1 shows the family in question. Each case, with pertinent findings, will be discussed separately.

REPORT OF A FAMILY

GENERATION I

Case 1. A white woman, now deceased, about whom no history other than "bad eyes all her life" is known, is listed as suspected of having macular involvement.

GENERATION II

Case 1. A woman, aged 48 years, who had experienced defective vision since early childhood.

Ocular findings. Visual acuity was: O.D., 1/20 corrected to 6/20 with a +2.75D. sph. ⊃ +4.75D. cyl. ax. 15°; O.S., 1/20 corrected to 6/20 with a +3.0D. sph. ⊃ +4.5D. cyl. ax. 170°.

Funduscopic examination showed: O.D. an irregular, yellow-brown degeneration of the macula. A clearly demarcated, circular area similar in nature but of lesser degree enveloped the more central degeneration just described. The entire involved area measured 1½ disc diameters in size (fig. 1); O.S. showed a similar degeneration of lesser size but greater intensity (fig. 2).

FIGS. 1 TO 8 (BERKLEY AND BUSSEY). (FIGS. 1 AND 2) CASE 1 OF GENERATION II. O.D., THE ENTIRE INVOLVED AREA MEASURED 1½ DISC DIAMETERS; O.S., THE AREA OF DEGENERATION WAS SMALLER BUT OF GREATER INTENSITY. VISION: O.U., 1/20, CORRECTIBLE TO 6/20. (FIGS. 3 AND 4) CASE 1 OF GENERATION III. O.D., THE IRREGULARLY SHAPED LESION HAD A YELLOW CENTER AND A BROWNISH, PIGMENTED BORDER; VISION, 1/20, CORRECTIBLE TO 2/20. O.S. SHOWED A SIMILAR BUT MUCH OLDER LESION; VISION, 1/20, CORRECTIBLE TO 7/20. (FIGS. 5 AND 6) CASE 3 OF GENERATION III. O.D., A WELL-DEFINED, SLIGHTLY ELEVATED DISCOLORATION WAS PRESENT IN THE MACULAR REGION; VISION, 16/20, CORRECTIBLE TO 20/20. O.S., A YELLOWISH DEGENERATION INVOLVED THE ENTIRE MACULAR AREA; VISION, 1/20, NOT CORRECTIBLE. (FIGS. 7 AND 8) CASE 2 OF GENERATION IV. O.D. A CENTRAL YELLOWISH DEGENERATION HAD A CIRCUMSCRIBED AREA OF APPARENT HYPEREMIA. VISION, 16/20, CORRECTIBLE TO 20/20. O.S., THE CENTRAL LESION WAS SURROUNDED BY A MARKEDLY HYPEREMIC BORDER; VISION, 1/20, NOT CORRECTIBLE.

As a child, this patient showed a convergent squint, but no muscle imbalance was now apparent.

Case 3. A woman, aged 51 years, first noted defective vision at the age of 40 years.

Ocular findings. Visual acuity was: O.D., 1/20 not further corrected with a +1.25D. sph.; O.S., 5/20 corrected to 16/20 with a +2.75D. sph. ⊂ −2.5D. cyl. ax. 95°.

Funduscopic examination revealed: O.D., an irregularly shaped, rusty, "salt-and-pepper" appearing area of macular degeneration measuring about 2½ disc diameters in size. The degenerated portion was clearly demarcated from the rest of the macula (pictures not obtainable); O.S., a small, sharply demarcated, homogeneous circular lesion about one third disc diameter in size, located in the region of the macula. A rusty, irregular degeneration was noted at the upper border of the lesion. This portion of involved retina appeared to have an increased vascularity, a condition common to the macular area of the right eye.

Case 4. A man, aged 45 years, refused to submit to examination, stating, "I've been to eye doctors all of my life and none ever help me." This case is listed as suspected of having pathologic conditions similar to others in the family.

Case 5. A man, not available for examination, who is listed as suspected on the basis of a history of "bad eyes."

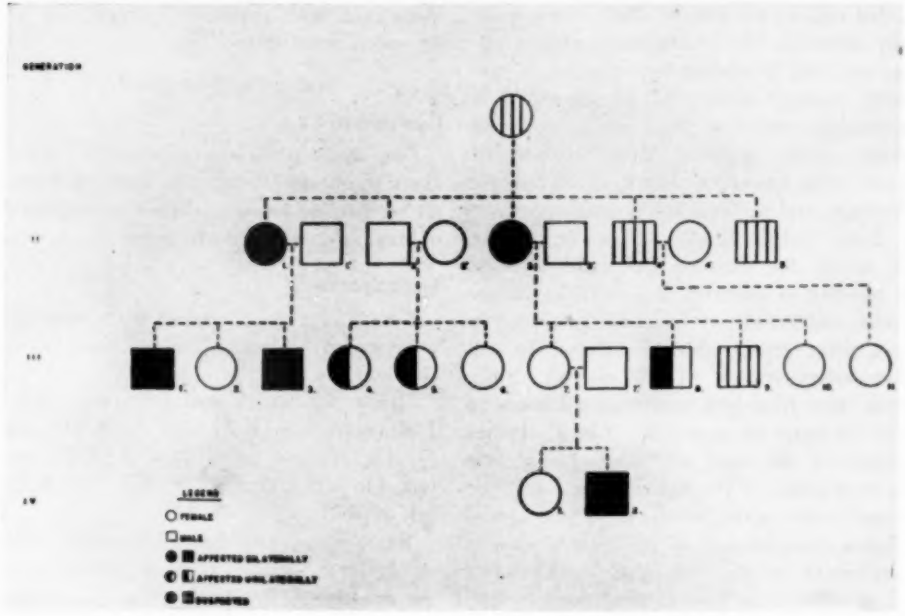

Chart 1 (Berkley and Bussey). Occurrence of macular degeneration in a family group.

Generation III

Case 1. A young man, aged 19 years, was known to have defective vision in the left eye since the age of 12 years. One year ago he began to have defective vision in the right eye.

Ocular findings. Visual acuity was: O.D., 1/20 corrected to 2/20 with a +2.5D. sph.; O.S., 1/20 corrected to 7/20 with a +4.5D. sph.

Funduscopic examination showed: O.D.,

an extensive area of degeneration in the macular region. The lesion was irregularly shaped and was composed of a yellow center with a brownish, pigmented and poorly demarcated border that contained occasional fresh hemorrhage. The involved area measured about 2 disc diameters in size and was encompassed by a circular area of perimacular edema. (Examination recently revealed the lesion to be quiescent with subsidence of the hemorrhage and the perimacular edema. See Figure 3.); O.S. showed a similar but much older lesion as evidenced by pigment deposits, lack of hemorrhage, edema, or other evidence of activity (fig. 4).

Field studies showed the peripheral field to be normal but the presence of central scotomas (fig. a). There was also a moderate degree of left hypertropia.

Case 2. A young woman, aged 18 years, was free of any apparent macular involvement. She is listed merely to note the presence of a marked weakness of the left superior rectus with resultant right hypertropia.

Case 3. A boy, aged 14 years, noted defective vision in the left eye at the age of 12 years. There were no complaints referable to the right eye save the need for the refractive correction.

Ocular findings. Visual acuity was: O.D., 16/20 corrected to 20/20 with a +3.0D. sph. ⊃ +1.0D. cyl. ax. 120°; O.S., 1/20 not improved with refractive correction of +4.5D. sph. ⊃ +0.75D. cyl. ax. 90°.

Funduscopic examination showed: O.D., a well-defined, circular, slightly elevated discoloration in the macular region. The lesion measured about 1½ disc diameters in size (fig. 5); O.S., presented an irregular, yellowish degeneration of the entire macular area (fig. 6).

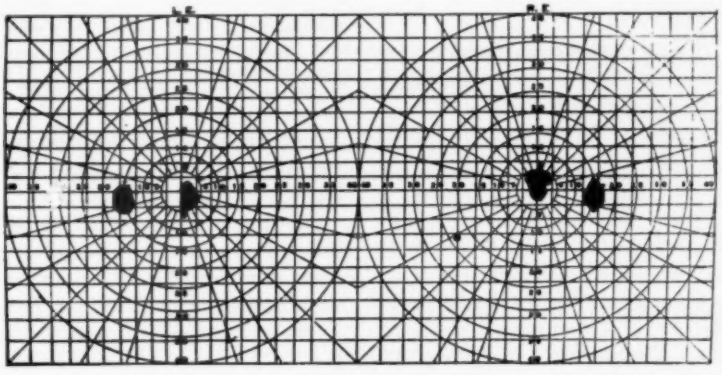

Fig. a (Berkley and Bussey). Visual field studies of Case 1, Generation III, showed a normal peripheral field with the presence of central scotomas.

Case 4. A young woman, aged 25 years, has had no complaints referable to the eyes.

Ocular findings. Visual acuity was: O.D., 16/20 corrected to 20/20 with a +1.5D. sph.; O.S., 20/20.

Funduscopic examination showed: O.D., the macula had a definite moth-eaten appearance typical of an early stage of degeneration; O.S., normal.

Case 5. A woman, aged 23 years, complained of "weakness of the right eye."

Ocular findings. Visual acuity was: O.D., 16/20, not further correctible; O.S., 20/20.

Funduscopic examination presented: O.D., a rusty appearance of the macula with a small amount of punctate stippling which is considered characteristic of an early stage of macular degeneration; O.S., normal.

Case 8. A man, aged 28 years, had no visual complaints.

Ocular findings. Visual acuity was: O.D., 20/20; O.S., 20/20.

Funduscopic examination showed: O.D., a faint homogeneous and circular area of apparent degeneration was present in the macular region; O.S., normal.

Case 9. A man, aged 26 years, was not available for study. Listed as suspected on basis of history of longstanding "bad eyes."

Generation IV

Case 2. A boy, aged 8 years, had a history of poor vision in the left eye since infancy.

Ocular findings. Visual acuity was: O.D., 16/20 corrected to 20/20 with a +2.0D. sph.; O.S., 1/20 not further corrected with a +4.5D. sph., the retinoscopic finding.

Funduscopic examination showed: O.D., the macular area had a central yellowish degeneration with a circumscribed area of apparent hyperemia more than 1 disc diameter in size (fig. 7); O.S., the macula had a distinct circular degenerative area about 1½ disc diameters in size. The central lesion was surrounded by a markedly hyperemic border (fig. 8). Examination six months later showed development of some pigmentation in both eyes.

An esotropia was present in early childhood, but the condition had been slightly improved by his refractive correction.

Discussion

Genetically, this family revealed "a condition of dominant transfer with imperfect penetrance" according to a personal communication from Dr. T. H. Dobzhansky.[4] He further stated that "if Case 2* in Generation II and Case 7* in Generation III had evidence of the disease, the conditions for perfect dominance would have been satisfied." Rechecks were done of these two cases but no evidence could be found of any pathologic condition.

According to the pattern of onset, which in this study showed a wide variation (from infancy to adulthood), it is still possible that these two cases may develop evidence of the disease. This is especially true of the individual in Case 7 of Generation III who is still relatively young.

* Not reported herein.

Pathogenesis

The literature is sparse and nonrevealing as to a definite pathology or etiology of heredodegeneration of the macula. Lues, tuberculosis, and other systemic diseases have been designated as causative factors. Ferrié[5] recently presented four additional cases of degenerative macular disease associated with definite evidence of tuberculosis. However, it would appear that this finding was merely coincidental.

There was no evidence to suggest consanguinity, lues, tuberculosis, or central nervous-system disorder in any of the cases we have presented. The optic nerve in most of the cases showed a definite temporal pallor. This observation has been noted in connection with degenerative macular disease by others (Crawford[6]).

Generalities drawn from this report

The disease is interesting from the standpoint of the ophthalmologist and the geneticist, and should be borne in mind in studies of macular abnormalities. Much assistance to the patient may be offered in the form of correction of refractive error, assurance that blindness will not ensue, and elimination of unnecessary empirical approaches to therapy.

Summary

1. A family group showing positive occurrence of macular degeneration in 8 cases and possible occurrence in 3 additional cases is presented.

2. Color illustrations representative of typical lesions are shown.

3. The cases are reviewed individually and certain associated findings are noted. These include similar funduscopic appearance, hyperopia with and without astigmat-

tism, muscle imbalances, central scotomas, temporal pallor of the nervehead, red hair, and color blindness.

4. Onset (clinical) seemed relative to periods of physiologic stress and cases are listed as occurring at infancy, puberty, adolescence, early adulthood, and presenile period.

5. The hereditary transfer in this family was "dominant with imperfect penetrance."

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We wish to express our appreciation to Dr. Frances Richman who saw the first case (Case 1, Generation II); to Dr. Raymond E. Meek, consulting ophthalmologist, St. Albans Naval Hospital, for his aid at the time the family was studied; and to Miss Pat Ranier, the artist who made the color drawings.

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CORRELATION OF THE CEREBROVASCULAR RESISTANCE AND THE GRADE OF HYPERTENSIVE RETINAL FINDINGS*

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Within recent years there has been an increasing interest in the hypertensive patient. Many hypertensive patients are being studied with the hope that they may improve following a thoracolumbar sympathectomy. It is not always a simple matter to determine which patients may be expected to benefit from the operative procedure. Various studies are employed in order to aid in the proper patient selection. Studies such as electrocardiogram, orthodiagram, influence of sodium-amytal narcosis on blood pressure, effect of a differential spinal, cold-pressor test, tests of renal function, and eyeground evaluation are all made. At present hypertensive patients are being studied at the Hospital of the University of Pennsylvania by a group of physicians who hope to correlate their data and, perhaps, eventually to arrive at some firm basis on which to select patients for surgical treatment. During this study the eyegrounds have been examined and classified according to the retinal vascular findings.

The classifications of eyeground findings as suggested by Wagener, Keith, and Kernohan,[2] and others, were deduced primarily on the duration of life of the patient and the severity of the hypertension. It seems desirable, if possible, to correlate these grades of hypertensive retinal changes with other physiologic factors. Such an opportunity presented itself among the hypertensive patients following measurement of their cerebral blood flow. Other data in this same study are reported elsewhere.[1] In this study it has

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been shown that the cerebral blood flows are normal in the hypertensive patient.

From the cerebral blood flow the cerebrovascular resistance can be calculated.* The cerebrovascular resistance may be recorded as the pressure reuired to drive 1 cc. of blood through 100 gm. of brain tissue per minute. similar alteration in the resistance of the cerebral vessels?

Twenty-one hypertensive patients and three nonhypertensive patients were studied. All the eyegrounds were graded according to the method of Wagener, Keith, and Kernohan.[2] It is admitted that it is not always possible to decide which type of sclerosis exists or to differentiate sclerosis and spasm, and that many ophthalmologists disagree in their interpretation of actual retinal findings. This classification, however, has been accepted as a helpful guide by many ophthalmologists. The fundi were graded by this method without any previous knowledge of the cerebrovascular resistance.

TABLE 1

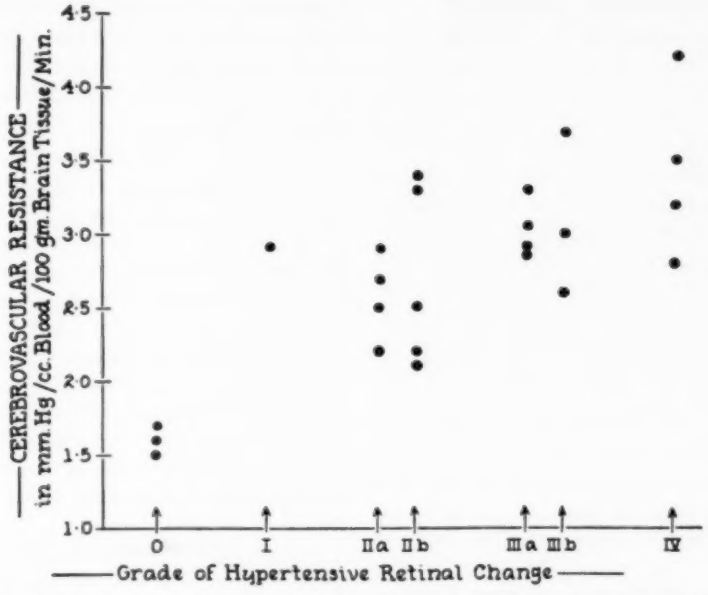
CEREBROVASCULAR RESISTANCE AND GRADE OF RETINAL VASCULAR CHANGE IN HYPERTENSIVE PATIENTS

Patient	Age Yrs.	Sex	Color	Mean B.P. mm. Hg	Cerebral Blood Flow cc./100 gm. B.T./min.	Cerebrovascular Resistance mm. Hg cc./100 gm. B.T./min.	Retinopathy Grade
D. M.	30	M	W	85	57	1.5	0
S. H.	26	M	W	93	58	1.6	0
J. B.	23	M	W	90	53	1.7	0
J. F.	46	M	C	120	57	2.1	2
F. H.	54	F	W	124	56	2.2	2
H. H.	31	F	W	146	66	2.2	2
B. P.	37	F	W	159	63	2.5	2
L. T.	46	M	C	137	55	2.5	2
F. L.	26	M	W	142	54	2.6	3
L. S.	48	M	W	171	64	2.7	2
F. B.	43	F	W	173	62	2.8	3
A. S.	26	F	C	160	57	2.9	1
L. M.	26	F	C	144	52	2.9	3
L. R.	47	M	W	157	54	2.9	2
N. B.	50	F	W	126	44	2.9	3
R. A.	34	M	W	158	52	3.0	3
G. J.	48	M	C	161	52	3.1	3
D. K.	38	F	W	190	59	3.2	4
N. M.	47	F	C	155	47	3.3	2
P. M.	62	M	W	133	42	3.3	3
M. Mc.	47	F	W	175	52	3.4	2
M. O.	40	F	W	190	54	3.5	4
J. M.	49	M	C	166	45	3.7	3
L. G.	38	M	C	159	38	4.2	4

The cerebrovascular resistance can be compared with the grade of retinal vascular change. At the same time another important factor can be evaluated. Since controversy exists as to whether retinal vascular changes reflect the state of the cerebral vessels, our observations appear to offer a new approach. Does increased retinal vascular resistance, as judged by narrowed vessels, sclerotic vessels, hemorrhages, and exudates, suggest a

The cerebral blood flow was measured by the nitrous-oxide method of Kety and Schmidt.[3,4] This employs the use of a gas mixture consisting of 15-percent N_2O, 64-percent N_2, and 21-percent O_2. Specimens

* The cerebral blood flow (cc. of blood passing through 100 gm. of brain tissue per minute) divided into the mean blood pressure equals the cerebrovascular resistance.



Graph 1 (Leopold, *et al.*). Cerebrovascular resistance in patients with various grades of hypertensive retinal changes.

for analysis were withdrawn simultaneously from the jugular bulb and femoral artery. Mean arterial blood pressure was obtained by means of a damped mercury manometer attached to a needle in the femoral artery. Cerebral metabolic rate in terms of cerebral oxygen consumption and cerebrovascular resistance were calculated as previously described.[3] Blood gas analyses were made in the Van Slyke-Neill manometric apparatus.[5] Potentiometric measurement of blood pH was made anaerobically at 37°C. by means of a glass electrode. Values for blood carbon-dioxide tension were calculated by means of the nomograms presented by Peters and Van Slyke.[5]

The results of the ophthalmoscopic gradings of the cerebral blood flow and the cerebrovascular resistance for each patient are listed in Table 1. It can be seen from a study of Table 1 and of Graph 1* that there is a tendency for the grade of hypertensive retinal change to increase as the cerebrovascular resistance increases. The statistical method†

* In an attempt to spread out the largest groups for graphing purposes, Wagener's Grade II was subdivided into IIa and IIb on the basis of the severity of spastic or sclerotic change. Grade III was also broken arbitrarily into a and b. Less than 10 hemorrhages and exudates in both eyes placed the eye in Grade IIIa.

† Spearman's formula was employed for this calculation

$$\text{rho} = 1 - \frac{6\Sigma(D^2)}{N(N^2-1)}$$

Where rho is the measure of correlation
D is the difference between the two ranks given for each individual
N equals the number of individuals
The coefficient of correlation (r) can be found by the formula

$$r = 2 \sin \frac{(\Pi \text{ rho})}{6}$$

In the case of ties of rank, the bracket method was employed. In this method all ties are assigned the same rank, but the next higher individual is given

of measuring correlation from ranks showed that a significant correlation existed.

From these results it is evident that when the retinal vessels showed signs of hypertension, the cerebrovascular resistance was elevated. Although there is a definite tendency for the grade of retinopathy to increase as the cerebrovascular resistance increases and this has been shown to be statistically significant, it is also true that overlapping occurs. A patient with retinal changes of a Grade I degree may have an increased cerebrovascular resistance that might also occur in a patient with a Grade II or III type of fundus. Although there is a direct relationship between the retinal and cerebral circulation, it is also evident that one cannot accurately predict from an ophthalmoscopic study of the retina and retinal vessels in a single individual the exact extent to which the cerebrovascular resistance has been elevated.

It is conceivable that, if other types of sclerosis, such as localized and diffuse atherosclerosis, could be more thoroughly separated from hypertensive retinal vessel changes, a different correlation might exist for, in all probability, these factors also influence cerebral blood flow and cerebrovascular resistance.

the rank that would have been assigned if the ties had received successive ranks.

r was found to be 0.67 and p was less than 0.001, indicating a high degree of statistical significance.

Summary

1. The cerebrovascular resistance was calculated from measurements of the mean blood pressure and of the cerebral blood flow, and the eyegrounds were evaluated in 21 hypertensive and 3 nonhypertensive individuals.

2. A statistically significant correlation was found to exist between the grade of retinal hypertensive change and the cerebrovascular resistance. The relationship was a direct one in that as cerebrovascular resistance increased, the grade of retinopathy also tended to increase.

3. It is evident that the retinal findings do reflect with some accuracy the state of the cerebral circulation but the degree of accuracy is not marked in that one cannot predict from the ophthalmoscopic findings the exact extent to which the cerebrovascular resistance has been elevated.

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ESSENTIAL PROGRESSIVE ATROPHY OF IRIS*

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The purpose of this article is to report three cases of essential atrophy of the iris, two of which showed peripheral anterior synechias in the region of developing iris atrophy. Such a relationship seen in a relatively early development of the disease suggests that the atrophy may be secondary to traction upon the delicate iris tissue. The third case was complicated by a severe secondary glaucoma which suggests that peripheral anterior synechias would have been seen if either a slitlamp or gonioscope had been available for the examination.

Essential iris atrophy is an uncommon disease, occurring predominantly in young women, in which the tissue of the iris disappears slowly and without symptoms. These patients usually consult an ophthalmologist because of an eccentric pupil or symptoms of secondary glaucoma which commonly accompanies the condition. Fortunately, the disease is rarely bilateral.

The atrophy usually begins in such a way that the pupil becomes eccentric and eventually may be pulled to the base of the iris. During this time the pigment epithelium often becomes everted. Opposite the displacement of the pupil, small holes may appear either superficially in the anterior layers or perforating the entire thickness of the stroma. Later these enlarge and may even coalesce. Less frequently the disease begins in another way. Small depigmented areas are noted first. These gradually extend in size and fuse to involve the different layers or entire thickness of the iris.

Although this disease is rare, reports of cases have been appearing in the literature with not too irregular frequency since 1886.[1] Because gonioscopic examination has been done in only five cases (McKeown,[2] Post,[3] Scharf,[4] and Sugar[5]) such an examination of our first patient is of interest.

CASE REPORTS

CASE 1

History. Mrs. A. R., aged 37 years, white, was first seen on April 29, 1947, through the courtesy of Dr. Francis Heed Adler. She had noted that the pupil of the right eye was irregular. Vision was 6/7.5 in each eye uncorrected.

External examination was normal except for the eccentric right pupil which was displaced slightly downward and considerably outward. Both pupils reacted promptly, although the lower outer third of the right pupil seemed quite immobile. Two pigmented areas could be seen at midportion on the iris of the right eye (fig. 1).

Ophthalmoscopy. On the temporal side of the right undilated pupil a space between the iris and the lens exposed the anterior portion of the ciliary processes. The iris appeared to be pulled forward by some cicatricial process in the angle. No mass was seen.

Slitlamp examination revealed that the right iris angle had been obliterated from approximately the 7- to the 8:30-o'clock positions; the iris appeared to be drawn in this direction with resultant pupil displacement. Neovascularization was seen at the point of adherence. No evidence of a perforating injury could be found. The dark areas on the iris previously mentioned represented areas

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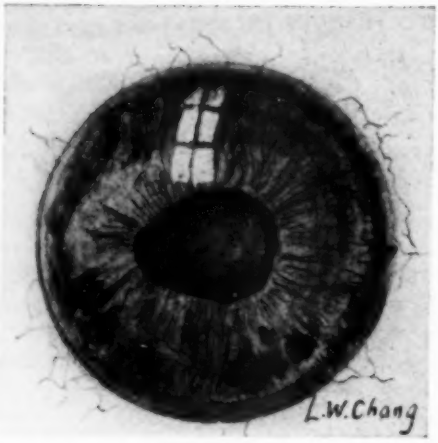

Fig. 1 (Chang and Ojers). External appearance of right eye as seen through a magnifying glass. The deviation of the pupil and holes of iris are clearly shown. (Case 1.)

of atrophy in the stroma with exposure of the pigment layer. In being displaced, the iris had been pulled so far forward that it was no longer in contact with the lens from the 4- to the 10:30-o'clock positions.

Gonioscopy of the same eye showed extensive peripheral anterior synechias from the 7- to 8:30-o'clock position. Further synechias were found, both at the site of the stromal atrophy (5 o'clock) and at 10 o'clock. The iris at the areas of the larger synechias was pulled forward in such a manner that the underside of its posterior layer and the anterior portion of the ciliary body were visible. No mass could be visualized pushing the iris forward (fig. 2).

Tension was 25 mm. Hg (Schiøtz), O.U., on August 25, 1947. No increase of tension was found on successive visits. Peripheral synechias were more extensive on September 27, 1947.

Case 2

History. The following case of F. W., a 23-year-old white soldier, was contributed by Dr. Harold G. Scheie. The left eye showed a marked iris atrophy with displacement of the pupil temporally.

Gonioscopic examination could not be done but slitlamp examination demonstrated extensive peripheral anterior synechias in the direction of atrophy. The pupil was pulled away from the lens, permitting visibility of the ciliary process between the iris and the lens, much as seen in Case 1. The rest of the ocular examination, including tension, was normal.

Case 3

History. Miss H. N. C., Chinese, aged 15 years, was admitted to the Central Hospital, Nanking, April 17, 1947, because of progressive visual loss since childhood, greatly accentuated in the last month.

Visual acuity (with and without correction) was: O.D., hand movements at 30 cm.;

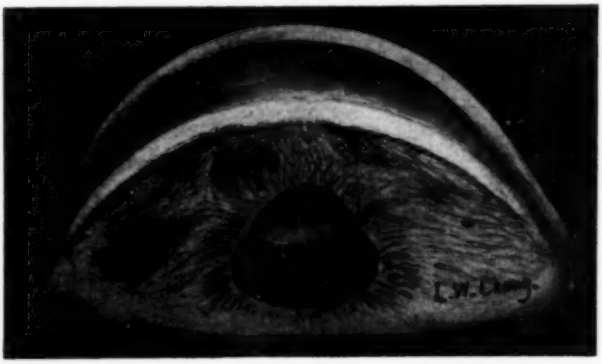

Fig. 2 (Chang and Ojers). Angle chamber of right eye viewed with gonioscope. Note the peripheral anterior synechias pulling the pupillary border toward the periphery and exposing the ciliary processes. (Case 1.)

O.S., finger counting at 30 cm. Examination of lids and adnexa of both eyes was negative.

O.D.: The cornea was normal. The anterior chamber was shallow. A large colobomatous iris defect extending to the ciliary body was seen from the 5- to the 9-o'clock positions. Just at the apex of the coloboma was a small elongated hole which contracted sluggishly to light. There were no visible synechias nor ectropion of the pigment margin. Although normal crypts could be seen in the brown iris, there was no distinction between ciliary and pupillary zones (fig. 3, O.D.).

The lens was clear, and its equatorial margin could be seen through the coloboma. Fine white shreds, presumably exfoliating lens capsule, and tiny pigment deposits were present over the anterior surface. The vitreous was clear.

The eye grounds were seen with a −20D. lens. The pale disc was deeply cupped on the temporal side, and an area of choroidal atrophy extended from this side to the normal appearing macular region. Coursing over the tessellated retina were normal retinal vessels.

O.S.: The iris was similar in structure and color; however, the defect was so huge that it occupied about two thirds of the chamber. The defect was kidney-shaped and extended to the temporal limbus from the 1- to 5-o'clock positions. From the 2- to 3:30-o'clock positions a small iris nubbin was seen attached to the ciliary body. There was a small hole at 9 o'clock which extended to the limbal region. As pilocarpine caused this area to constrict, it was assumed to be the remainder of the pupillary aperture. Fine pigment deposits and white shreds were scattered over the surface of the transparent lens. The vitreous was clear (fig. 3, O.S.).

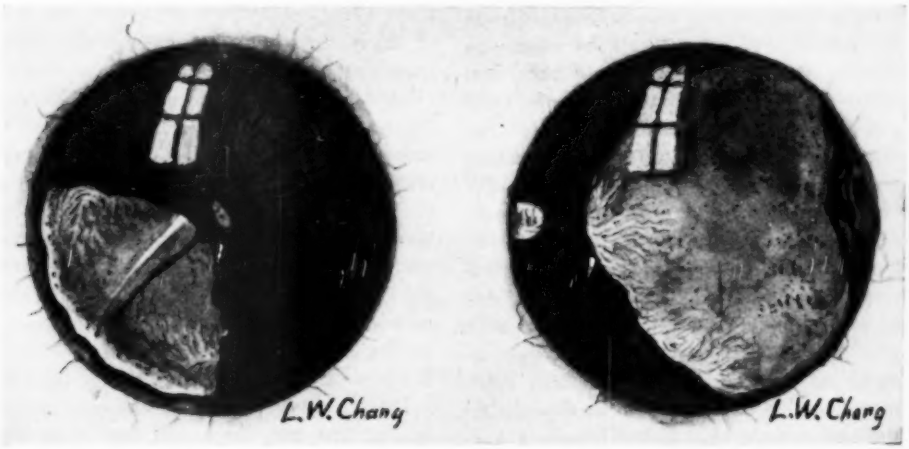

Fig. 3 (Chang and Ojers). External appearance of right and left eyes examined with a loupe. Note the colobomatous defects in both eyes. An attempt has been made to show the white shreds and pigment deposits on the anterior capsules of both eyes. (Case 3.)

The fundus was seen with a −25D. lens and appeared essentially the same as described for the other eye, except the cupping of the disc was not so pronounced.

Tension was: O.U., 54 mm. Hg (Schiøtz). Visual fields could not be taken because of poor vision. Tension was brought down to 17 mm. Hg, O.U., by the use of pilocarpine nitrate (2 percent) every two hours.

The ultimate outcome, however, is unknown, for the patient was observed for only one week before she returned to the interior of China.

Discussion

In a review of the literature of essential iris atrophy, Henderson and Benedict[6] divided the reported cases into three groups. Group I consisted of those cases with no demonstrable cause for the atrophy and uncomplicated by glaucoma. Group II was the same as the above except glaucoma was present when the case was first seen. Group III included all those cases in which the atrophy was suspected to have been secondary to some etiologic agent. Our first and second cases belong to Group I. But our third case is puzzling and may well belong to Group III.

While the appearance of the lens capsule in this last case was that of exfoliation (by loupe examination), the earliest case of glaucoma capsulare previously reported has been in a 41-year-old man (Gradle and Sugar[7]). It is possible, of course, that the process responsible for the atrophy was also detrimental to the capsule. Pigment deposits on the lens capsule may well represent a low-grade inflammatory process. On the other hand, pigment deposits are seen in some cases of primary glaucoma. It is of further interest that this case is bilateral. Only six bilateral cases have been reported (Yao,[8] Fine and Barkan,[9] McKeown,[10] Rosenberg,[11] and Czukrasz[12]) and doubt has been expressed as to the diagnosis in the case reported by Fine and Barkan (Henderson and Benedict[6]).

As so often happens when proof is difficult, many theories as to etiology have been presented. Larson[13] feels the condition is a congenital anomaly. Feingold[14] also suggests it is of congenital origin but places the disturbance in the blood vessels of the smaller iris circle. De Schweinitz[15] suggests some autotoxin or possibly abiotrophy.

A cytolytic process representing a perversion of a normal embryonic function has been postulated by Krieker[16] and Jeancon.[17] Von Grosz[18] favors a neurogenic factor. Vascular change is mentioned by Zentmayer[19] and Lane.[20]

Mechanistic theories start with the thought that the atrophy is secondary to the stretching of the iris (Rochat and Mulder[21]). This idea is carried further by Waite[22] who suggests an interference with the blood supply caused by the narrowing or occlusion of the radial vessels as a result of the pull on the iris tissues. The fact that our first two cases were seen to show atrophy in the line of stress caused by the peripheral synechias would support these mechanistic theories.

Evidence as to the causes of glaucoma characteristically complicating the later stages of essential iris atrophy has been well reviewed by Sugar.[5] The constant findings of peripheral anterior synechias, both by gonioscopic examination and microscopic study of enucleated eyes, appear to support Rochat's and Mulder's hypothesis[21] that the cementing together of the iris and cornea results in the slow obliteration of the chamber angle with a consequent rise in tension.

Peripheral anterior synechias were found in our first two cases, but they were not complicated by glaucoma. This need not be surprising. Only as these cases progress to the point where synechias become sufficiently extensive to embarrass the drainage system of the angle will the intraocular pressure rise. It has been estimated that as little as 70 to 90 degrees of an arc of normal angle is sufficient to allow a normal tension in narrow-angle glaucoma with peripheral anterior synechias (Kronfeld[23]). Although no synechias were seen in the case of the Chinese patient, who did have a marked rise in ocular tension, it seems almost certain that peripheral anterior synechias would have been revealed by a slitlamp or gonioscopic examination.

Conclusion

1. Three cases of essential iris atrophy are presented.

2. Peripheral anterior synechias were

demonstrated by either slitlamp microscopy or gonioscopy (or both) in Cases 1 and 2. It is felt that anterior synechias were probably present in Case 3 because of the presence of secondary glaucoma.

3. The peripheral anterior synechias in the first two cases were so situated that the atrophy of the iris could well have been due to the mechanical displacement and subsequent stress on the iris.

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Ophthalmic Miniature

The more attentively we observe the phenomena of disease, and consider the effects of remedies, the more we shall be led to adopt simplicity of treatment, and the less confidence shall we place in complicated plans, or great diversity of remedial means.—Sir William Lawrence, *A Treatise on the Diseases of the Eye*, 1833.

INVESTIGATION OF THE BLOOD-AQUEOUS BARRIER IN THE NEWBORN*

I. To Ascorbic Acid

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The objective of these studies was to investigate aqueous-humor dynamics in the newborn. Information on this subject may be essential for an understanding of the significance and possible relation of several manifestations of eye pathology observed in retrolental fibroplasia. Specific structural abnormalities which may be related include shallow anterior chamber, thin and elongated ciliary processes, and presence of a vascular system behind the lens. Abnormally low ascorbic acid concentration of the aqueous humor in eyes with retrolental fibroplasia[1] (approximately that found in the blood) indicates that the composition of the aqueous humor differs from that characteristic of the normal, adult human being.

In preliminary studies,[2] the level of ascorbic acid in the aqueous humor of the rabbit at birth was shown to be the same as in the plasma. After the 9th day, a progressive increase occurs until the normal adult level (25 to 30 mg. percent) is reached approximately 27 days after birth. This was thought to indicate that secretion by the ciliary body does not start until the animals are approximately 9 days old.

Further consideration of the implications of these results suggested that the situation is probably more complex, and that additional investigations were necessary for a clearer understanding of the changes undergone in the dynamics of intraocular fluids in the developing eye.

The immediate objects of the present paper were, first, to determine whether the changes in concentration of ascorbic acid in the aqueous humor of other species vary with age in a manner similar to that in the rabbit, and secondly, to consider other mechanisms which might account for the experimental findings.

Methods

Samples of aqueous humor were obtained from rhesus monkeys varying in age from newborn to 4 years.† In all instances, the aqueous humor was transferred directly from the microsyringe used for collection of the sample into tubes containing 0.2 ml. of 5-percent metaphosphoric acid. After centrifuging, analysis for ascorbic acid was made by titration with 80 mg. percent 2,6 dichlorophenolindophenol, again utilizing micro techniques.

The specimens of aqueous humor from infants were obtained as soon after death as possible; the time elapsing between death and collection of the sample varied from 45 minutes to 48 hours. Since all of the samples collected 12 hours or more after death fell within the normal adult range, it is assumed that little, if any, destruction of the vitamin occurs *in situ* in the eyes of infants who were placed in cold rooms prior to autopsy. In addition to the samples of aqueous humor obtained after death, several specimens were obtained from eyes enucleated from living individuals.

Results

The ascorbic-acid concentrations of aqueous humor obtained from monkeys of var-

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† The monkeys (Macaca mulatta) for this study were made available through the courtesy of Dr. G. van Wagenen of the Department of Obstetrics and Gynecology, Yale University School of Medicine. The colony is maintained through funds donated by the Nutrition Foundation, Inc., New York, New York.

ious ages are given in Figure 1. The concentration from the day of birth until shortly after the first month of life is 2 to 3 mg. percent, or approximately the same level as that in the blood. Following this, the concentration increases until the adult level of 16 to 19 mg. percent is reached about the 6th month.

The ascorbic-acid content of aqueous humor obtained from human beings of different ages is plotted in Figure 2. While the data are few, they seem to indicate that (1) the concentration increases during the last 2 months of fetal life, and (2) individual variation of concentration of ascorbic acid in the aqueous humor at birth is less than that encountered later in life. Because of the variation in the ascorbic-acid content of the adult aqueous humor, the normal level cannot be well defined. However, the ascorbic-acid concentration of the aqueous humor of the full-term infant falls within the range of that of the normal adult having an adequate ascorbic-acid intake.

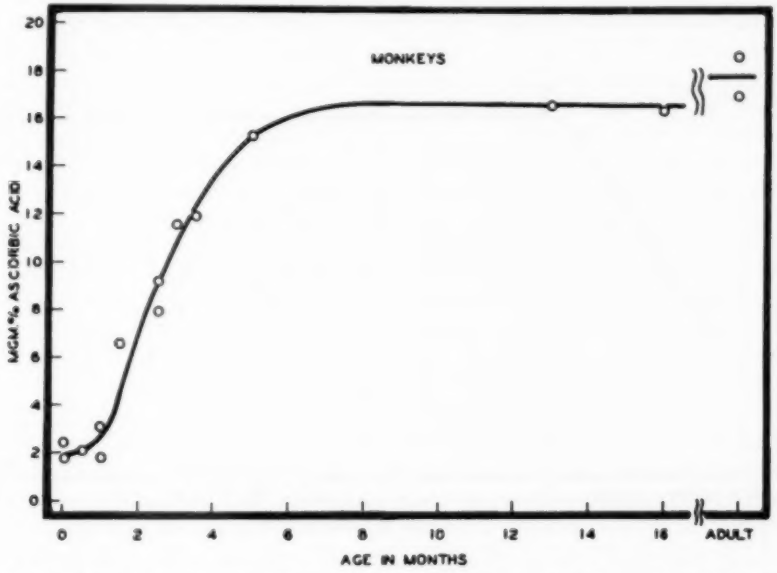

Fig. 1 (Kinsey and Jackson). This graph shows the concentrations of ascorbic acid in the aqueous humor of monkeys at various ages.

Discussion

The results of all three species studied—the rabbit, monkey, and man—indicate that the aqueous humor dynamics during the developmental stages of the eye differ markedly from those of the adult with respect to ascorbic acid at least. It seems worthwhile to consider the possible factors which might account for this variation.

As a basis for understanding alterations in the mechanism of aqueous-humor dynamics, particularly as they relate to the transfer of ascorbic acid, some of the factors thought to influence the accumulation of this acid in the adult eye will be described.

Ascorbic acid is believed to act as a mediator in the oxidation-reduction reactions thought to be associated with the transfer of electrolytes from the blood to the posterior chamber.[3] In the chain of energy-yielding reactions, the vitamin apparently is oxidized to the dehydro form, in which state it is presumed to diffuse into the aqueous humor to be reduced by the sulfhydryl

groups in the lens. To account for the relatively high concentration in the aqueous humor compared with that in the blood, it is further assumed that the blood-aqueous barrier is less permeable to the diffusion of ascorbic acid than to dehydroascorbic acid. Steady-state conditions are further dependent upon the rate of loss of ascorbic acid from the anterior chamber by the flow or leakage process described elsewhere.[4]

Thus, the eventual concentration of ascorbic acid in the aqueous humor may be dependent on (1) the rate of secretion and/or diffusion of dehydroascorbic acid into the aqueous humor, (2) the capacity of the lens to reduce dehydroascorbic acid to ascorbic acid, (3) the relative permeabilities of the blood-aqueous barriers to the oxidized and reduced forms, and (4) the rate of outflow.

Of the factors listed above, the only one discussed heretofore[3] to account for differences in concentration of ascorbic acid in the newborn and that reached subsequently was alteration of the rate of secretion. Final evaluation of this factor should properly be delayed until evidence is obtained from direct studies of the ciliary body at different ages, using the techniques devised by Friedenwald and Stiehler for selective transfer of acid and basic dyes by ciliary epithelium and stroma, distribution of the enzyme systems associated with the secretion, and so forth.[5]

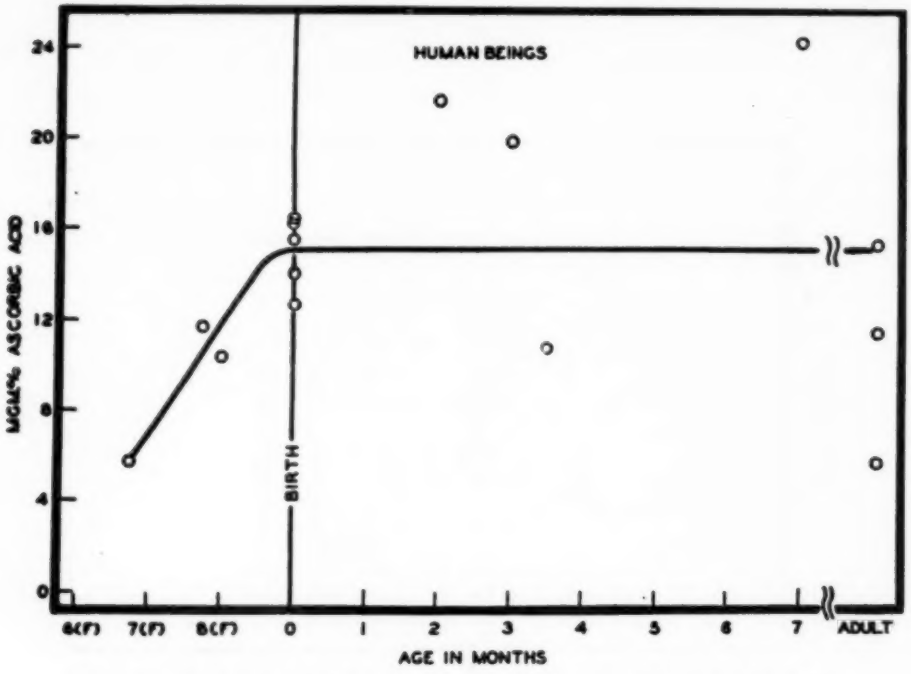

Fig. 2 (Kinsey and Jackson). This graph shows the concentrations of ascorbic acid in the aqueous humor of human beings at various ages.

Regarding the capacity of the lens at various ages to reduce the dehydroascorbic acid to ascorbic acid, analysis of a 1-day-old rabbit lens showed the glutathione concentration to be 169 mg. percent. This concentration is approximately half that found in the normal adult and, assuming that its rate of re-

newal is at least as high as that in the adult lens, it would be more than sufficient to reduce the small quantity of dehydroascorbic acid transferred into the aqueous humor of the eyes in the animals at this age. It may be significant, too, that the ascorbic-acid concentration of the lens is already at the normal adult level (11 mg. percent).

The third factor already mentioned which influences the concentration of ascorbic acid in the aqueous humor is the relative permeability of the blood-aqueous barrier to the diffusion of ascorbic and dehydroascorbic acids. In the adult, the chief sites of the blood-aqueous barrier are the iris and ciliary body, but in the eye of the newborn the tunica vasculosa lentis network of the hyaloid system must also be considered as part of the blood-aqueous barrier.

It is pertinent to follow the condition of the hyaloid system during the period in which the concentration of ascorbic acid in the aqueous humor is increasing to the level characteristic of the adult eye. The rabbit eye at birth is richly supplied by the hyaloid system. At this time, the ascorbic-acid level in the aqueous humor is the same as that found in the blood. By the 9th or 10th day after birth, although the system has regressed significantly, blood is still circulating through it, and the ascorbic acid concentration of the aqueous humor is still at blood level. By the 14th or 15th day, however, the vessels have disappeared completely, and the concentration of ascorbic acid in the aqueous humor is increasing but has not yet reached the level found in the adult eye.

Information now available concerning the time of regression of the hyaloid system in the rhesus monkey is incomplete, being limited to observations made on the eye of a single animal obtained on the day of birth. In this eye, the lesser branches of the hyaloid system were already partially closed. It is possible that the hyaloid vessels of the monkey may continue to function to some degree for several weeks after birth. If this is true, the age at which the hyaloid system regresses in the monkey also seems to coincide with onset of increase in concentration of ascorbic acid in the aqueous humor.

In human beings, the main trunk of the hyaloid artery shrinks considerably during the 7th month of fetal life, and the pupillary membrane begins to atrophy. By the end of the 9th month, the pupillary membrane and the hyaloid artery have practically disappeared.[6] Analysis of the sample of aqueous humor obtained from the youngest human fetus (6¾ months) suggests that at this stage the ascorbic-acid concentration has already begun to rise. Thus, in man also, the time of regression of the hyaloid system parallels the initial increase in concentration of ascorbic acid in the aqueous humor.

The analyses from all the species therefore indicate a reasonably close time relationship between the breakdown of the hyaloid system and the initial rise of ascorbic acid in the aqueous humor. The final (adult) level of ascorbic acid does not, however, coincide with the complete regression of the hyaloid system in all the species. In the rabbit, the delay amounts to about 12 days; in the monkey, possibly as long as 4 to 5 months; and in man, the correlation appears to be relatively closer—of the order of 2 weeks. Direct experimental evidence has been obtained that ascorbic acid exchanges between blood and aqueous humor in the rabbit during the 12-day period following closure of the hyaloid system more freely than it does in the adult eye.[7]

The possible effect produced by variations in the rate of outflow on the concentration of ascorbic acid in the young and adult animal remains to be discussed. Kinsey and Grant[4] have considered the influence of this factor on the distribution of solutes between the aqueous humor and the blood under steady-state conditions and have expressed the relationship mathematically.

If it is assumed that in the adult rabbit eye the major loss of ascorbic acid is by flow, and evidence for this has been obtained,[7] and also assumed that the relative

rate of secretion of ascorbic acid into the posterior chamber is the same for young and adult rabbits, then it follows that the rate of outflow would have to change tenfold to account for the tenfold change in ratio of concentration in the aqueous humor to concentration in the blood, that is, from 20 found in the adult rabbit to 2 as found in rabbits 8 to 10 days old.

While changes in permeability factors of this order of magnitude are frequently encountered, it seems unlikely that any factors known to influence the rate of flow, such as intraocular pressure or changes in width of the angle, would vary to such a degree.

In conclusion, it seems that the observed changes in concentration of ascorbic acid could be accounted for almost entirely by changes in the permeability of the blood-aqueous barrier undergone during this period of development. From the fact that the ascorbic-acid levels in the aqueous humor and blood were indistinguishable during the period in the life of all the species when there is a discrete hyaloid system present, it might be inferred that the presence of this vascular system alone could account for the experimental findings. The subsequent delay in the rise of ascorbic-acid concentration of the aqueous humor suggests that the barrier properties of the iris and/or ciliary body are also changing during the time interval under consideration. It is possible also that simultaneous variations may occur in the secretory rate and perhaps in rate of leakage.

Summary

The ascorbic-acid concentration of aqueous humor has been determined in young monkeys (Macaca mulatta) and in infants of various ages. In the monkey, as was shown previously for the rabbit, the concentration increases from that in the blood to that characteristic of the adult eye during the period 6 weeks to 6 months after birth. In the human being, a similar rise occurs between the 6th and 9th fetal months.

The following factors were discussed to account for the experimental findings:

1. Increased rate of secretion.
2. Capacity of lens to reduce dehydroascorbic acid to ascorbic acid.
3. Variations in properties of blood-aqueous barrier.
4. Alterations of outflow.

The observed changes in concentration of ascorbic acid seem to correlate best with regression of the hyaloid system and subsequent changes in the permeability of the iris-ciliary body barrier between the blood and the aqueous humor.

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TRAUMA TO THE HEAD WITH PARTICULAR REFERENCE TO THE OCULAR SIGNS*

PART II.† INJURIES INVOLVING THE HEMISPHERES AND BRAIN STEM; MISCELLANEOUS CONDITIONS; DIAGNOSTIC PRINCIPLES; TREATMENT

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3. HEMISPHERE AND BRAIN-STEM LESIONS

HEMISPHERE LESIONS

In addition to the temporary neurologic signs produced by intracranial collections of blood, a variety of neurologic defects may remain following injury to the hemispheres and brain stem.

Monoplegia, apraxia, hemianopia, aphasia (sensory and motor), and cortical blindness may follow cortical lacerations produced by indriven bone fragments and foreign bodies. Injury to a major vessel, especially the middle cerebral or one of its larger branches, results in hemiplegia. Signs produced by injuries tend to be pronounced at first and to show great improvement with passage of time.

Lacerations at the base of the frontal and temporal lobes are a common occurrence and produce extensive subpial and subarachnoid hemorrhages. Not infrequently large parts of these lobes are reduced to a hemorrhagic necrotic pulp. While signs of high intracranial pressure are prominent, few localizing symptoms are seen. Convulsions may be severe.

Lowered blood pressure due to hemorrhage or shock may predispose to thrombosis. Often thromboses develop while the patient is conscious. The occlusions may be arterial or venous. Depending upon the extent of the thromboses various symptoms ensue. Coma, asphyxia, and hemiplegia are most often seen. Dural sinuses may become thrombosed and produce tremendous increase in the intracranial pressure. Cerebral paraplegias (superior longitudinal sinus) and proptosis (cavernous sinus) are occasionally seen.

Ocular Signs of Hemisphere Lesions

Apart from conjugate deviations of the eyes which are associated with epileptiform seizures (occurring in a small percentage of cases of head trauma) pronounced deviations of the eyes occur infrequently as a result of injury to the head.

Frontal lobe lesions. It might be anticipated that injury to the frontal lobe would often produce pronounced deviation of the eyes (to the side of a destructive lesion and away from an irritative lesion). Undoubtedly such deviations occur in some instances but they do so rarely and we have not observed them. It is to be assumed that the anterior oculogyric pathways are interrupted infrequently. This applies also to the posterior oculogyric pathways if pronounced conjugate deviation is an accurate criterion.

Prefrontal lobotomy affords an interesting example of frontal lobe trauma. In such cases we have not observed pronounced deviation of the eyes in any instance. Occasionally there has been inabilty to move the eyes on request for a short time following operation but this has been inconstant and seemed to be due to lack of attention.

Pseudohemianopia develops in some instances of excision of a frontal lobe. In some such cases there has been a transitory deviation of the eyes to the side of the removal; also there has been what appeared to be defective perception in the contralateral visual field. This is not a true hemi-

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† "Part I. Injuries involving the cranial nerves" appeared in the February, 1949, issue of the JOURNAL on pages 191-206.

anopia and probably represents only lack of attention.

Lesions of the parietal lobe. Lesions involving the parietal lobe produce sensory involvements predominantly. Among these are sensory fits, loss of postural sensibility, and loss of tactile discrimination in the areas of the body on the opposite side corresponding to the cortical representation.

Stimulation of the angular gyrus produces conjugate deviation of the eyes to the side opposite the stimulation just as in the instance of stimulation to Area 8 of the frontal lobe. Also there may be deviation of the eyes to the side of a destructive lesion. Such ocular deviations are neither as pronounced nor as constant in their occurrence as when the frontal lobe is involved. The ocular deviations associated with lesions involving this secondary center are due to interference with the optic fixation reflexes; that is, they influence the posterior oculogyric pathway.

The angular gyrus is an area which is considered of great importance. It is thought of as a center for word-memory. Lesions situated in this general region produced word blindness (alexia). There are various types and degrees of word blindness. In its purest variety it is fairly well agreed that the angular gyrus region usually is affected.

Henschen's[31] extensive work on this shows, however, that pure word blindness may be associated with lesions situated elsewhere in the cortex. With word blindness there may be an associated hemianopia, and it is recalled that involvement within the parietal lobe may directly involve the optic radiation. It has been suggested that a lesion in the superior portion of the cuneus may produce alexia and that it may originate in involvement of the occipital lobe or as the result of a lesion in the corpus callosum.

Spatial agnosia has resulted from bilateral involvement of the angular gyrus as described by Holmes[33] in traumatic cases. His patients exhibited errors in judgment as regards distances, walking into obstacles in the path, inability to count coins, accommodation retardation, and loss of the blink reflex as well as loss of stereoscopic vision.

Riddoch[33] described such cases when the phenomena observed in Holmes's cases were present only in the homonymous half-fields. Trescher and Ford[34] described a case in which there was loss of object vision in the homonymous half-fields as a result of splitting of the corpus callosum; also in their case there was loss of topographic memory which characterized some of Holmes's cases.

Brain[35] has described such anomalies of vision as are mentioned above in a person whose fields were normal. Defects in integration of visual perceptions at a higher level than the primary projection areas arise from lesions involving the parietal, occipital, temporal, and even the frontal lobes. Our present knowledge regarding the lesions responsible for these abnormalities is incomplete. They have little significance in topical diagnosis other than they arise as a result of injuries in the region of the angular gyrus and posterior to it.

Lesions of the temporal lobe. In this lobe, visual-field defects are the outstanding characteristic. Homonymous sector-shaped defects indicate interruption of the lower portion of the optic radiation where the fibers are fanned out in the forward portion of the temporal lobe. Sector defects and complete homonymous hemianopia with or without sparing of the macula originate in interruptions of the optic radiation at the level of the temporal lobe. In some instances the field defects are not completely congruous, as has been pointed out by Harrington.[36] The suggestion that incongruity of the defects is due to pressure upon or involvement of the underlying optic tract has been mentioned by Traquair[37] in the instance of tumorous involvement.

Occipital lobe lesions. The cortical localization concept of Holmes and Lister[38] was established during World War I on the basis of a study of war wounds, and during World War II has been verified. Other evidence

which supports this localization concept has been obtained from patients who have been subjected to removal of part or all of an occipital lobe.

Occipital lobe lesions may be responsible for deviation of the eyes due to interference with the optic fixation reflexes.

Total blindness results from removal of the occipital lobes. Removal of one occipital lobe results in hemianopia which may or may not be characterized by "sparing" of the macula. It is our concept that the macular fibers do not cross after reaching the geniculate body, and that Verhoeff's[39] explanation for "sparing" is correct in all probability. He has pointed out that interference with the optic fixation reflexes may account for sufficient unsteadiness of fixation so that "sparing" results; in anteriorly situated lesions where "splitting" is encountered the optic fixation reflexes are not influenced.

Posterior injury of the occipital lobes produces central scotomas as shown by Holmes, and later by Greear and McGavic.[40] The central field defects have usually been associated with other field defects.

Homonymous quadrantic defects have come to be recognized as indicative of a radiation lesion but not necessarily a lesion of the occipital lobe. Complete loss of the lower visual fields, or homonymous quadrantic defects in the lower fields, have been observed to result from trauma. With penetrating injuries such loss of upper visual fields must be rare because the injury which produces them in this instance would penetrate dural sinuses and death would occur immediately.

Feigenbaum and Kornblueth[41] described ring scotomas in the visual fields as a result of injury to the occipital lobes. Greear and McGavic described bilateral homonymous hemianopia as a result of war injury. Holmes[42] charted completely congruous homonymous field defects originating in injury to the occipital cortex. From this brief recounting it would seem that the field defects associated with occipital lobe injuries may vary widely; they are congruous and, of course, homonymous.

We wish to draw attention to a group of cases seen in civilian practice which may be compared with cases seen as a result of war wounds. In cases in which air is injected into the posterior horn of the lateral ventricle there may be loss of vision which it would seem obvious must be attributed to involvement of the occipital lobes in large part.

In such cases we have observed almost complete blindness as a temporary phenomenon, bilateral homonymous hemianopia, and homonymous paracentral scotomas. In the cases with which we are familiar the visual defects and associated visual field changes have always cleared in greatest part, usually completely. These cases are comparable with other traumatic cases since trauma, even though elective, initiated the symptomatology. Again, similar to the traumatic cases, the initial loss of visual field is much more pronounced than the final field defects.

It was stated in the first paragraph of this paper that lesions involving the visual association pathways are not considered in any detail in this paper. The subject is extremely complicated and contentious. However, we may point out that alexia (word blindness) and object blindness (mind blindness) are each reported to have arisen as the result of occipital lobe injury. They are closely related affections or different degrees of the same type of involvement.

Convergence and divergence paralysis. We have seen what seemed to be examples of convergence and divergence paralysis in cases of head injury. Convergence paralysis has been observed on several occasions, usually as a late result. Divergence paralysis occurs less frequently. The diagnosis of divergence paralysis invariably had been made with some misgiving.

It is our belief that convergence and divergence palsies resulting from trauma, or from any cause, do not prove or disprove the existence of supranuclear centers concerned with the indicated capacities. All supranu-

clear centers, so-called, are theoretical and have not been demonstrated anatomically; they make possible visualization of associated ocular movements.

Immediately after trauma has occurred to the head, sometimes when it has been mild, there is incoördination in the movements of the eyes amounting to dissociation. Usually as the patient recovers the eyes become parallel, or, less often, muscle palsies develop.

With severe head trauma, divergence of the eyes is commonly observed during the period of unconsciousness. When such divergence is associated with dilated pupils the prognosis is grave.

Observation of injury cases does not clarify the situation as regards cortical control of convergence and divergence. However, it is quite certain that such control exists. Divergence of the visual axes during deep sleep, deep anesthesia, and following trauma supports this concept.

Cortical Blindness

Mention has already been made in this paper of bilateral homonymous hemianopia, which, in the absence of "sparing of the maculas" amounts to cortical blindness in many instances. There are several prerequisites to the diagnosis of cortical blindness. As enumerated by Marquis[43] these are: (1) Complete loss of all visual sensations including loss of appreciation of light and dark; (2) loss of lid closure reflex on exposure to bright light and threatening gestures; (3) retention of pupillary response to light stimulation, and on convergence; (4) normal retinas on ophthalmoscopic examination; (5) normal motility of the eye.

In cases of cortical blindness there may be hemiplegia, sensory disorders, aphasia, and disorientation, and consequently the diagnosis often is difficult. Not uncommonly individuals who are quite blind maintain that they can see; this is known as anosognosia.

Cortical blindness undoubtedly occurs as a result of injury, but it occurs infrequently in its complete form as defined above. In cases of blindness, partial or complete, following injection of air into the posterior horn of the lateral ventricle it seems probable that there is a degree of cortical blindness. In such cases blindness may be the only symptom. The fact that such patients recover in almost all instances is proof that there has not been death of cells. It seems probable that spasm of the posterior cerebral arteries may account for such blindness in many instances.

Visual Hallucinations

We have had little or no experience with visual hallucinations as a result of trauma. Weinberger and Grant[44] concluded that visual hallucinations have no value in topical diagnosis. They found that they were associated with lesions involving the optic pathways at many levels. They concluded that they represented psychologic phenomena involving the total integrative activity of the mind, and depended upon constitutional factors and not on cortical psychic organization. Our experience points to temporal lobe involvement when hallucinations are "formed" and to the occipital lobe when they are sensations, such as lights.

BRAIN-STEM LESIONS

Closed injuries to the brain produce widespread multiple, small hemorrhagic petechias. If the hypothalamus, midbrain, and pons are traumatized, hyperthermia, tonic fits, and respiratory distress are seen. The tonic fits are spontaneous or follow painful stimuli. Their presence gives a grave prognosis since when they appear the injury is rarely survived. Tonic neck reflexes are sometimes present.

Hemorrhages and edema about the aqueduct of Sylvius may occlude it, producing acute hydrocephalus. Many of the incoördinated eye movements and transient cranial nerve palsies which are associated with injury may be so produced. Frequently multiple small hemorrhages in the brain stem

are the only postmortem finding in patients who die as a result of head trauma.

Cerebral edema produces prolonged unconsciousness and many deaths. This is particularly true when the vital centers at the base of the brain are involved. Trauma to the cerebral hemispheres may result in a similar symptomatology as a result of herniation of the temporal lobes through the tentorium and of the cerebellum through the foramen magnum.

Because of such herniation the respiratory centers and other vital centers in the pons and medulla are compressed, thus resulting in prolonged coma or death. Under such circumstances, neurologic findings are the result of a combination of direct pressure, indirect pressure, acute hydrocephalus, and anoxia. Frequently it is quite impossible to state what produces any particular symptom.

Recently Kremer, Russell, and Smyth[48] have described several cases of severe head injury with damage about the aqueduct. They found that ataxia, incoördination, and prolonged loss of ability to speak were outstanding symptoms.

Ocular Signs of Brain-Stem Lesions

Frequently it is impossible to determine the precise site of the lesions which are responsible for incoördination of the eye movements in cases in which there has been injury to the base and presumably injury to the brain stem. It is our belief, however, that injuries to the brain stem are productive of transient ocular muscle palsies in a large percentage of cases of head injury in which recovery occurs.

Ptosis, either unilateral or bilateral, is not an uncommon finding. Certainly it occurs more frequently than definite conjugate deviation of the eyes or pronounced weakness of conjugate movement. In a majority of cases of injury to the brain stem the incoördination of the extraocular muscles is not pronounced. Probably when pronounced paralyses occur with lesions at this level the patient rarely survives.

Usually it is impossible to differentiate between nuclear and intranuclear lesions in such cases on the basis of examination of the eyes. Nuclear lesions involving the third nerve can be predicted with some degree of certainty, certainly not lesions involving the fourth and sixth nerves unless, with the sixth, there is an associated seventh nerve palsy.

Conjugate deviations of the eyes which originate in brain-stem lesions, notably in the pons, tend to be permanent as compared with deviations which originate in lesions of the hemispheres which tend to be transient.

Nystagmus and other involuntary movements of the eyes. Not uncommonly following trauma to the head there are involuntary coördinated movements of wide amplitude which resemble searching movements. These often come on as consciousness is returning. They are transitory and of no localizing significance.

In a small percentage of cases there is jerky nystagmus of wide amplitude seen in individuals who, while conscious, invariably vomit and complain of severe dizziness and unsteadiness. They present the picture of an acute labyrinthitis and usually suffer from fracture of the temporal bone in the region of the semicircular canals. In our cases such individuals usually have exhibited unilateral deafness.

Certainly, when following trauma nystagmus is present in association with deafness, the localization is obvious; there has been fracture of the temporal bone or damage to the vestibular apparatus.

In other injury cases when nystagmus persists the nystagmus probably points to brain-stem damage. Nystagmus which may be dependent on interference with optic-fixation reflexes is a very uncertain affection.

4. Miscellaneous conditions

Fat embolus

When head trauma occurs, other parts of the body are often severely traumatized. Particularly when the long bones are fractured,

fat emboli may complicate the neurologic status. The lesions are produced by free liquid particles of fat in the blood stream. These particles plug the capillaries and small veins producing focal areas of necrosis.

The injury which produces fat emboli may be mild or severe. Fractures of bones, jarring of the skeleton, and trauma to the subcutaneous and intramuscular fat and to fatty visci sets liquid fat free. If there are severed veins in the vicinity, the fat may be forced into them. Usually there is a latent period of 48 to 60 hours before the appearance of symptoms, which, however, occasionally appear within 30 minutes.

Microscopic sections of the brain shows capillaries and the smaller vessels filled with fatty globules. Around plugged vessels there is an area of necrosis surrounded by a ring of hemorrhage. All parts of the brain are affected.

Vance[48] reported fat emboli in the lungs and kidney in 102 of 104 fatal traumatic cases. However, fat emboli were severe in only 11 cases and were considered as productive of the fatal termination in three instances.

The earliest symptoms are dyspnea, restlessness, tachycardia, and precordial pain. Then there is insomnia, memory disturbances, disorientation, and delirium. Stupor and coma develop in the terminal stages. As the coma deepens there is rigidity and tonic convulsions. In the terminal stages the muscles become flaccid and there is loss of sphincter control. Death due to respiratory failure supervenes about 1 to 4 days after the onset of coma.

Fat emboli in the retina are observed infrequently, but in all probability they are present more frequently than reported cases would suggest. Certainly they are not usually looked for in cases of trauma, or in fracture cases. Our experience is limited to a single case in which there was no history of trauma to the head. There were no visual symptoms suggesting the presence of retinal fat emboli.

The patient, a young girl, had suffered a fracture of the tibia, and a member of the house staff on doing a routine ophthalmic examination, detected the retinal changes which were observed several days after the accident occurred. Within 2 or 3 weeks the retina had become entirely normal. At no time had there been any reduction of visual acuity.

Retinal fat emboli appear as patches of white semihard exudates situated in the superficial retina about the posterior of the eye. In the single case we have studied the accumulations were circular. Some were almost as large as the disc, others were much smaller. In one instance, an underlying vessel was hidden from view. Most of the patches were well away from the retinal vessels. In our case there was gradual disappearance of the patches without development of scar.

Cardiac responses to injury to the head and face

Firm pressure on one or on both eyeballs slows the normal pulse rate and frequently reduces the rate of an auricular tachycardia. This response is known as the oculocardiac reflex. Often it is associated with a sensation of faintness and nausea.

It has been assumed that there is a reflex arc connecting the fibers of the ophthalmic nerve with the nucleus of the vagus. Pressure on the eye, or perhaps pain in the eye, or pressure within the orbit, sets up a train of action which ultimately stimulates vagus fibers thereby producing an inhibitory action on the heart, gut, and vasomotor tone. Exact connections between the fifth and tenth nerves have not been demonstrated histologically. The reflex has been observed as a physiologic phenomenon from pressure of the fingers, also as a result of intraocular infections, intraorbital hemorrhages and injections, and blows on the face which produce bruising and edema.

It immediately becomes apparent that the presence of the oculocardiac reflex in an individual who has suffered an injury to the

head may cause confusion as regards the diagnosis. Recently we observed a child who was struck just below the eye with a baseball bat. He was brought to the hospital to have a superficial laceration of the cheek treated.

When he was examined it was noted that he had an enlarged, oval pupil on the side of the injury. The pupil did not react to light either directly or consensually; there was a small amount of blood staining of the lower eyelid and it was thought there might be mild intraorbital hemorrhage. The pulse rate varied from 54 to 60 beats per minute.

He was observed for several hours without any change in his pulse rate, or any change in the abnormal pupil. On the following day his pulse rate had increased to 64 to 68 beats per minute. On the second day after the accident occurred the pulse rate was again within the range of normal for his age, 76 to 80 beats per minute. The child was not unconscious at any time.

Bradycardia seemingly present as an oculocardiac reflex may last for several days. In a child who had been kicked in the face over the lateral wall of the orbit, there was pronounced orbital hemorrhage with proptosis; there was pronounced limitation of all extraocular movements but no paralysis of any muscle. There was slight clouding of consciousness, and complaint regarding headache. There was severe nausea and occasional vomiting. The respirations were 16 to 24 per minute, and the pulse rate was 48 to 56 beats per minute. The patient was up and walking about. The pulse rate persisted essentially unchanged for four days and then periods of normal rhythm (70 to 76) developed.

It seemed as if the sinus node was being either stimulated or released from the control of the vagus intermittently. During this time, the orbital hemorrhage was subsiding and the ocular movements were improving. By the time the heart had resumed its normal rhythm, the orbital condition had almost completely cleared. The child was lucid at all times.

Knowledge regarding the occurrence of the oculocardic reflex is important in evaluation of head injuries. The slow pulse rate suggests increased intracranial pressure due to a subdural or extradural hemorrhage, or cerebral edema. However, the history of injury about the eye, and physical findings limited to the eye and orbit will usually allow one to come to the proper conclusion. In cases of doubt, the patient should be carefully observed in a hospital until there is no question about the diagnosis. It is to be recalled that the state of consciousness is of utmost importance. Usually the pulse rate is not significantly slowed without some impairment in consciousness.

Another phenomenon that we have noted in a few patients with basilar fractures or injuries to the base of the brain is periods of pulsus bigeminus. This may persist in short bursts for several days. Turning or otherwise stimulating the patient will frequently abolish the rhythm. Nurses checking the pulse of such individuals may report 30 to 40 beats per minute since every alternate beat is missed at the wrist.

The mechanism responsible for pulsus bigeminus is not at all clear. It may be related to the oculocardiac reflex. It may be due to abnormal stimuli applied to the hypothalamus. The electrocardiogram shows periods of extra systoles alternating with a normal rhythm. This has suggested that anoxemia was producing the extra systoles but clinically the patients were breathing normally and did not exhibit cyanosis.

We have observed this cardiac arrhythmia for as long as a week after injury. The periods gradually get shorter and shorter with longer intervals between them and eventually they disappear. In the cases we have studied the heart has been found to be normal.

Here again the significance of the cardiac rate must be understood. When it appears as an isolated finding, one is not justified in assuming that the patient is suffering from an intracranial hemorrhage or increased in-

tracranial pressure. The state of consciousness, the respiratory rate, and the temperature will be the best guides in evaluating the requirements for treatment.

Arteriovenous fistulas

Carotid-cavernous sinus fistulas are a relatively frequent sequelae of head injuries. The frequency is probably due to the unique anatomic situation, where an artery is actually surrounded by a venous sinus. This does not occur elsewhere in the body, and it is the only place inside the head where a large artery and vein lie in close approximation. Congenital intracranial arteriovenous aneurysms need not be commented upon here since they are developmental anomalies.

The site of injury producing a carotid-cavernous fistula is usually on the side of the head, about the lateral wall of the orbit or temporal region. Often the injury is so mild that consciousness is not lost. In nearly all cases there is a skull fracture that passes through the cavernous sinus. This may produce a tear in the wall of the carotid artery, or a fragment of bone may be driven into the wall of the artery.

The onset of symptoms is often rapid. The patient may notice a buzzing or humming noise in or behind the eye almost immediately, although it may be delayed. The examiner can easily hear a bruit with a stethoscope, usually loudest just over the eye. Detection of a bruit, even though it is pronounced, does not establish the diagnosis of carotid-cavernous fistula unless there is engorgement of ocular vessels and/or proptosis. The engorgement and pulsating exophthalmos may be delayed. We have on two occasions heard a bruit, one definite but soft, the other booming, in two patients neither of whom had a carotid-cavernous fistula.

Usually the conjunctiva becomes engorged and reddened within a few hours due to overfilling of the veins. In later stages it may become everted over the lower lid and we have observed alarming hemorrhages from such everted and swollen conjunctiva. Blood vessels of the sclera and lids also become overdistended within a short time.

Proptosis is delayed for several days but then proceeds quite rapidly. Following an initial increase, the exophthalmus progresses slowly. It is due to the overfilling of the ophthalmic vein. The globe pulsates synchronously with the heart beat.

Vision is good initially and the fistula may be present for many months before it is seriously affected. If the vision is poor or absent shortly after the injury, an additional lesion in the optic nerve or retina must be present. Ultimately, if the fistula is not closed as the result of operation, the visual acuity becomes low or is lost.

Papilledema in the affected eye is common according to Dandy. It occurs late. This is due to the venous engorgement. Extraocular palsies may be present, either due to direct trauma to the nerves, or due to the aneurysm with its distended veins. These palsies are usually incomplete, and often the motion of the eye is limited as a result of proptosis rather than a nerve palsy.

Pain may or may not be present, and often it is delayed in its onset. Horner's syndrome may occur if the sympathic fibers are interrupted. This is difficult to detect in the late stages.

The condition may persist for many years. We have seen a patient who had a carotid-cavernous fistula for more than 20 years. Proptosis was extreme, and vision almost gone from the affected eye. There was advanced primary optic atrophy. The veins over the lids, forehead, nose, and face were greatly distended and pulsated. The patient remarked that on occasions, these had ruptured spontaneously and that blood had spurted several feet. The hemorrhage was controlled with difficulty.

Dandy[1, 17] states that in 10 percent of cases the proptosis is bilateral. This is due to a persisting circular sinus that unites the two cavernous sinuses. He also remarks

that the proptosis is usually on the same side as the fistula but occasionally is present on the contralateral side. The bruit, however, is always loudest on the affected side.

Rarely the onset of symptoms is delayed for a few months. This is probably because the fistula is small. Besides blunt trauma, we have seen a case produced by a stab wound, in which the knife went through the supraorbital fissure and penetrated the wall of the carotid.

The diagnosis is usually not difficult. A history of trauma, distention of the veins about the eye, proptosis, and bruit are characteristic. Absence of the roof of the orbit may produce displacement of the globe, but the venous distention and the pulsation synchronous with the heart beat are not found. Tumors of the orbit and arterial aneurysms may produce proptosis and some degree of venous enlargement but bruit is absent.

Ligation of the internal carotid artery both intracranially and in the neck "traps" the fistula; it produces a cure in the majority of cases. Where the aneurysm has been present for a long time, it may be necessary to ligate the external carotid artery in addition because of collateral circulation. Ligation of veins in the orbit was at one time the only operative procedure. Now it is done only when venous distention persists after carotid ligations have been performed. In especially persistent cases, Adson[48] has found it necessary to ligate the ophthalmic artery; to cure the proptosis completely, he removed parts of the ophthalmic vein.

Intracranial bleeding

Intracranial bleeding is perhaps the most important complication of an acute head injury, and a fatal outcome may be due solely to bleeding that has resulted from trauma. The suspicion, detection, and evaluation of signs that hemorrhage may produce are highly important because prompt treatment is often life saving.

Blood may escape and collect in the following places: (1) Extradural space, (2) subdural space, (3) subarachnoid space, (4) subpial, (5) intracerebral, (6) intraventricular.

It is unusual for bleeding to develop at only one of these locations but it is common that one site may be the predominant site of hemorrhage while bleeding elsewhere is relatively unimportant.

For example, with a blow on the temporal region, a large extradural hematoma may form. Small subpial and intracortical hemorrhages in the temporal lobe may be produced at the same time but these do not change the clinical picture, or the treatment.

Each of the above subjects will be treated separately but it should be understood that, especially with severe injuries and compound fractures, any or all types of hemorrhage may occur simultaneously.

1. Extradural Hemctoma

Bleeding from a ruptured middle meningeal artery or its branches is the usual cause. Rarely bleeding from the other meningeal arteries or bleeding from bone may be vigorous enough to produce a significant collection of blood.

The trauma may be severe or slight. A localized injury to the temporal region, such as a blow from a blackjack, falling on a stone or curb or against a railing or step, is frequently sufficient to shear the middle meningeal artery.

Factors that permit the shearing of the artery are: (1) It is embedded in a groove in the bone so that a minor deformation of the contour of the skull may rupture it, and (2) the artery converges from the bone at right angles which permits easy shearing with small movements of the dura.

It has often been emphasized that a relatively mild injury has been sustained perhaps followed by a brief period of unconsciousness. There is then a lucid period for a varying number of hours followed by a return of drowsiness, loss of consciousness,

Jacksonian convulsions, and perhaps other localizing signs. While this history is not unusual, many cases never have a lucid period, so that deepening unconsciousness and the appearance of fresh neurologic signs are just as important.

The rapidity with which extradural hematomas may form make it an immediate surgical emergency. Usually the bleeding is sufficiently brisk to manifest itself within 1 to 6 hours. Only occasionally do symptoms first occur after 12 hours but we have seen two instances in which there were insufficient symptoms to lead one to suspect extradural bleeding for 3 days and 1 week respectively.

Besides the onset of drowsiness the appearance of facial twitches followed by focal convulsions involving the face and hand are early signs. There may be weakness of the facial musculature or of the extremities on one side of the body but these are always mild. The order of appearance of the weakness is of extreme importance. It is always face, arm, and finally the leg.

Ocular signs are of the greatest importance. Very early one may note sluggishness in the pupillary light reflex on one side. Later inequality develops. The dilated pupil soon becomes fixed to light. Ptosis is occasionally noted. It never is complete. While the dilated pupil is frequently on the side of the hematoma this is not invariable. Usually the patients have become so drowsy and uncoöperative that the ocular movements cannot be adequately tested. Not infrequently there is divergent strabismus. At other times coarse searching-type movements are noted. Papilledema is absent at first but occasionally it develops within 24 hours and usually is present in some degree thereafter. Dr. A. C. Woods and Dr. W. E. Dandy observed development of papilledema within 3 hours.

Other signs of increased intracranial pressure make their appearance rapidly. Most prominent is noisy, difficult respiration. By this time, the patient responds only to the most painful stimuli. When both pupils become dilated and fixed, the terminal event is not far distant.

Since many of the signs and symptoms discussed above are not pathognomonic for extradural bleeding, multiple bilateral diagnostic trephinations should be used freely in cases of doubt. The procedure is easily done under local anesthesia and is harmless. It is better to trephine many cases than to procrastinate too long and lose a patient with this easily remedied condition.

2. Subdural Hematoma

This condition varies according to acuteness and age of patient. Each type requires separate description. They are (1) acute, (2) chronic, (a) occurring in infants, (b) occurring in adults. The acute form is almost always found in association with other types of intracranial bleeding, frequently with severe injuries. Even after evacuation the mortality is high. In contradistinction, the chronic variety is almost always found in "pure culture" and the chances for survival following removal are excellent.

Acute. Bleeding into the subdural space after a severe injury may come from several places. The veins passing from the cerebral cortices to the dural sinuses may tear and cause a profuse hemorrhage. Vessels may also be ruptured by indriven bony fragments or during the process of a contrecoup injury.

Frequently acute subdural hematomas are thin. Associated conditions such as subarachnoid hemorrhage, cortical laceration, and cerebral edema occur concurrently, and the clinical picture presented by the patient is not characteristic. When found at operation or autopsy, it is difficult to say which of the conditions produced any given symptom.

Occasionally, however, these hematomas become massive, and cause marked compression of the brain. They may extend from nasion to inion and are not infrequently bilateral. At operation 200 to 300 cc. of blood

may be evacuated from a single side. Death is no doubt directly caused by the bulk of the hematoma. It has been our experience, however, that after the removal of the blood, extensive injury to the brain is almost always uncovered.

Even these massive hemorrhages frequently fail to produce localizing signs. The patient is usually deeply unconscious, often not arousing from the time of the injury. Signs of medullary compression such as difficult and irregular breathing may be the first evidence that the patient is losing compensation. Tonic fits may be seen but Jacksonian convulsions are uncommon unless there is a cortical lesion in addition. In the later stages a mild hemiparesis, or bilateral pyramidal tract signs, may appear.

Eye signs are varied, unreliable, and not characteristic. The usual divergence of the eyes and dilatation of the pupils seen with unconsciousness is common. Sometimes the pupils are small and react sluggishly to light. They may be unequal but rarely markedly so. Since the bulk of these patients are unconscious and cannot coöperate, evaluation of ocular signs due to midbrain and medullary compression are difficult.

Papilledema is extremely rare since patients with significant acute subdural hematomas rarely live more than 48 hours unless treated. In our experience preretinal (subhyaloid) hemorrhages occur in approximately 25 percent of these cases. Almost always there is an associated subarachnoid hemorrhage.

Small subdural hematomas of a few millimeters in thickness found either at operation or autopsy probably produce no special symptoms and are not responsible for the patient's condition.

Chronic subdural hematomas in adults. These collections of blood present quite a different clinical picture from those discussed above. Often it is impossible to connect them accurately with trauma. They occur very rarely below the age of 20 years, except in infancy. It is noted that they are most frequent in the 4th, 5th, and 6th decades of life. They are found 6 to 8 times more frequently in men.

Since chronic subdural hematomas have never been produced experimentally, the sequence of events in their formation and the course they pursue is inadequately understood. It is agreed that the trauma responsible for the initial bleeding is often exceedingly mild and that there may be a latent period without symptoms of from a few weeks to several months. Some authors believe that all the bleeding occurs at the time of injury while others present evidence to show that the hematoma increases its size as time passes. Rarely the mass calcifies and produces symptoms years later.

Sometime during their course, membranes form around the hematoma. The outer is thick and vascularized while the inner is thin. The outer membrane can be easily stripped from the dura but leaves a mass of bleeding points. In our experience the inner membrane can rarely be stripped from the pia without causing considerable damage to the underlying vessels and cortex.

The signs produced by chronic subdural hematoma are exceedingly variable, and they may simulate almost any intracranial condition. There may be the usual symptoms of intracranial pressure as headache, bradycardia, vomiting, drowsiness, and unconsciousness. Dandy emphasized that head pain as distinguished from headache may be a feature. Meningeal signs such as a stiff neck and a Kernig's sign may be present. Evidence of local pressure such as hemiplegia, aphasia, cortical sensory disturbances, and rarely convulsions may be produced. There are no characteristic signs. Lumbar punctures almost always yield normal spinal fluid often under normal pressure. In an adult who has suffered a head injury, and presents obscure signs suggesting brain injury, diagnostic trephinations and ventriculograms should be utilized.

In contrast to acute hematoma, ocular signs are fairly frequent and important. Papilledema may be present but is found in only about 17 percent of patients (Govan and Walsh[49]). It is precisely the same type that is observed in cases of neoplasm. It probably develops late in the course of the disease but sometimes the changes of the nervehead suggest that the papilledema is old. If of long standing, secondary optic atrophy may result. In a few instances pronounced loss of vision has occurred rapidly.

Pupillary changes are important in the diagnosis of subdural hematoma, but frequently the pupils remain normal. A dilated and fixed pupil, or a slightly enlarged pupil which reacts sluggishly to light, suggests a hematoma. Pupillary dilatation was found in only 10 percent of cases surveyed by Govan and Walsh but in about half the series reported by Kennedy and Wortis. Undoubtedly pupillary dilatation results more frequently from extradural than from subdural hematoma. We have observed unilateral dilatation of a pupil in a case of bilateral subdural hematoma.

Incomplete ptosis is relatively common and is almost always unilateral. It is usually on the side of the lesion but may be contralateral. Complete paralysis of the third nerve has not been recorded so far as we are aware. Except for the pupillary paralysis and ptosis the nerve remains intact. Unilateral, and occasionally bilateral, involvement of the sixth nerve is seen in a few cases and is probably due to the generalized increased intracranial pressure. Rarely is the fourth nerve involved. We have seen conjugate deviation of the eyes away from the side of the lesion. Since the deviation was persistent, it was thought to be due to interruption of the supranuclear pathways in the hemisphere contralateral to the hematoma.

Visual field defects are found in a few instances. Maltby[50] described them in 11 percent of his series. The defects were homonymous and contralateral to a clot in all but one instance when it was ipsilateral. We have seen one instance of a homonymous hemianopia for color.

Total blindness with advanced optic atrophy is rarely seen and it follows long standing papilledema. Nelson[51] stressed the ocular signs due to brain-stem compression. Nystagmus, loss of convergence, paralysis and disorganization of gaze were noted. These were thought to be due to lesions about the oculomotor and abducens nuclei and about the posterior longitudinal bundles.

In most instances the ocular signs subside rapidly after evacuation of the clot. The ptosis and inequality of the pupils may disappear in a matter of minutes; likewise do the palsies, aphasia, and visual field defects. The state of consciousness improves rapidly although the patient may be confused for weeks. Papilledema subsides more slowly, often persisting for a month. Visual loss due to optic atrophy is irreversible as are some of the brain-stem symptoms described by Nelson.

Hematomas in infants. Hematomas are fairly common in infants under the age of two years. Here again, trauma is important but the injury may be mild and escape notice. Some authors believe that the bleeding may start during delivery. Among infants, the difference in frequency because of sex is not pronounced as it is in adults. The general state of nutrition seems more important. Rickets and scurvy may well be predisposing causes.

The incidence of bilateral hematoma is much higher among infants. This probably accounts for the relative prominence of signs of increased intracranial pressure and the paucity of signs of local pressure. Tense and bulging fontanels are of the greatest importance and are almost constant. Diagnostic subdural taps through the fontanels should be done in every case where there are signs of pressure. Lumbar punctures are also of extreme importance. In almost all cases there is blood or xanthrochromic spinal fluid. A slight elevation of temperature is present in about one third of the cases.

Convulsions are very common. Govan and Walsh noted convulsions in 91 percent of infants and only 4 percent in adults. Vomiting occurs in about one half of the cases, while drowsiness and irritability are even more frequent. Coma may be the presenting symptom in as many as one fourth the number of infants.

The ocular signs are generally the same as those described in adults, with a few exceptions. The incidence of papilledema is about the same or perhaps less. One important point is the presence of subhyaloid retinal hemorrhages. They are very common in infants and are almost never seen in adults with hematomas. The reason for this is not altogether clear. Govan and Walsh have pointed out the difference in anatomy along the superior longitudinal sinus in infants and adults. In the former the pial veins are almost unsupported as they enter the sinus. This permits easy tearing in the event of trauma and, since the arachnoid is also extremely thin, it is probably torn simultaneously. This permits blood to escape into the subarachnoid space, thereby accounting for the blood in the spinal fluid.

Subarachnoid Bleeding

Blood in the cerebrospinal fluid is a frequent finding in head injuries of more than moderate severity. While it signifies a fair degree of trauma and its presence makes the prognosis somewhat more grave, the bleeding itself rarely produces symptoms or sequelae.

The hemorrhage may produce signs of meningeal irritation, a rise in temperature, and is not infrequently associated with preretinal hemorrhages.

If the injury responsible for a profuse subarachnoid hemorrhage is survived, certain late phenomena may occur due to the plugging by the blood of the absorbing mechanism of the cerebrospinal fluid. This produces an acute communicating hydrocephalus, with the usual signs of pressure, papilledema, and cranial-nerve palsies. When the condition is relieved either spontaneously or by operative measures, the signs and symptoms subside.

Intracerebral Bleeding

The most common form of intracerebral bleeding is multiple petechial hemorrhages. The clinical picture is usually that of concussion and the symptoms are not localizing. We have seen severely injured patients who exhibited divergent strabismus, horizontal nystagmoid movements, alternating dilatation and constriction of one or both pupils and, in the terminal stages, bilateral fixed and dilated pupils. In such cases one cannot be sure whether the signs produced are due to a localized lesion in the brain stem or generalized increased pressure. Even at autopsy this question is not answered. Individuals who survive such injuries may show certain changes attributed to lesions about the aqueduct of Sylvius. These have been discussed previously.

Large collections of blood sometimes form in the frontal and temporal lobes. Should the patient survive the acute phase of the injury, these intracerebral hematomas may produce signs typical of those of any intracranial neoplasm in the same position. Many absorb slowly and leave porencephalic cysts, their presence being asymptomatic. Large intracerebral hematomas are rare complications of head injuries. If they produce signs of pressure, they should be evacuated.

The Eyelids and Conjunctivas and Trauma

It is generally known that ecchymoses develop in the eyelids and conjunctivas as the result of trauma about the orbit which results in a "black" eye, and as a result of fractures in the base of the skull. Similar ecchymoses may occur under other circumstances when their origin is not easily understood.

When trauma is directly applied to the eye and orbit, as, for example, a blow from a fist, there is the development of a "black" eye. Immediately after the blow has been struck a purplish-red color of the eyelids and

extreme redness of the conjunctiva appear. After a day or two, the color changes to purple, then to green, then to yellow, and finally to normal.

Associated with discoloration of the eyelids and conjunctivas there may be dilation of the pupil; usually such a pupil is irregular in shape and sluggish in its response to light. There may be intraocular damage, such as detachment of the retina, tearing of the choroid, dislocation of the lens, or dislocation backward of the optic nerve, but such injuries are uncommon and as a rule a "black" eye is properly regarded as a trivial injury.

When there is a fracture in the anterior fossa extending into the orbit, the blood is said to extend along the torn dura and bone. It becomes visible several hours or even several days after the injury. Often the lower lid contains more blood than the upper and frequently there is "butterfly" distribution of the blood staining. The color is purplish rather than red.

Blakeslee[52] in studying 610 fractures of the skull found eyelid and conjunctival hemorrhage in about 17 percent of the cases. In some instances he observed that blood reached the eyelids when the fracture was situated far posteriorly. In such instances he visualized the blood extravasations as due to the explosive action of the force which had produced the fracture.

In several cases of fracture of the middle fossa, we have observed characteristic blood staining of the eyelids. In cases described by Grecar and McGavic there were massive intraocular hemorrhages when bullet wounds were situated far posteriorly; in such cases undoubtedly there were extensive subarachnoid hemorrhages.

Hamilton Bailey[53] made a useful differential diagnosis between "black" eye and hemorrhage into the eyelids and conjunctivas as a result of fracture of the base, and his observations conform largely to ours.

1. In fracture of the base the extravasated blood is limited sharply by the palpebral fascia to the orbital margins, and thus it tends to be circular. In "black" eye there is no such limitation.

2. With fracture of the base the discoloration of the conjunctiva is purplish from the commencement; whereas, with "black" eye it is beefy red. With "black" eye, hemorrhage is in the conjunctiva and the mass of hemorrhage moves when the conjunctiva is moved; in fracture of the anterior fossa the hemorrhage is subconjunctival.

4. With a conjunctival hemorrhage associated with "black" eye there is a posterior limit to the extravasation; whereas, in fracture of the anterior fossa there is no such limit and the hemorrhage tends to be fan-shaped with the handle of the fan toward the iris.

5. With fracture there is a parallelism between the edema and the amount of blood in the eyelids; that is, the greater the edema the greater amount of blood by inspection; with "black" eye with pronounced edema there is relatively little blood.

6. With fracture, the blood in the eyelids almost always is first seen at the medial border of the lower lid and gradually suffuses along the lids. It rarely joins the lesser suffusion in the upper lid at the outer canthus.

7. If the eyelids are everted the conjunctivas in a case of fracture usually are clear; whereas, with "black" eye they are edematous and discolored.

Ecchymoses in the eyelids following fracture of occipital bone. As an unusual example we may cite the case of a woman who fell forcibly into the sitting position. She developed the ocular picture of fracture of the base.

Ecchymoses in the eyelids following cranial operations. We have observed that following many transcranial operations there is pronounced edema of the eyelids and hemorrhages occur in them. The mechanism accounting for such extravasations is unclear. On first thought it would seem likely

that such hemorrhages resulted from taking down of the bone flap, but in many cases this can scarcely apply. The extravasation in many such cases is precisely that which is seen associated with fracture of the base. We have observed such extravasations following prefrontal lobotomy and following a transcranial operation when the subdural space was not entered.

We do not have an explanation for the ecchymoses which occur as the result of transcranial operations in which there has not been gross trauma applied to the skull, and such extravasations seem particularly mysterious when the operative effort has been directed to posterior aspects of the skull. It seems questionable that the explanation concerning fracture of the base, namely disruption of the periosteum, is valid in consideration of the fact that such lid extravasations occur under many circumstances when the base is intact.

Pneumocephalus

Following fractures of the skull, air may collect extracranially beneath the galea, or intracranially. Both of these conditions are rare.

Extracranial aeroceles. Fractures through the frontal sinuses or mastoid cells may allow air to escape beneath the galea and strip the scalp from the skull. Slight increases in the intraoral pressure may be sufficient to elevate large portions of the scalp, since it is so loosely adherent to the pericranium.

The spread of the emphysema is limited by the attachment of the galea and consequently does not spread like subcutaneous emphysema elsewhere in the body. Treatment is simple, since only aspiration is required. One should not be misled in the diagnosis.

The soft fluffy tumor in which crepitation can be felt is typical of gas in the soft tissues. Gas gangrene can be easily eliminated since it is practically unknown in the scalp and an infection necessary to produce so much gas would also give rise to alarming systemic symptoms, while pneumocephalus is often asymptomatic.

Intracranial aeroceles. As pointed out by Dandy,[54] air may collect in the subdural space, subarachnoid space, in the brain substance, and in the ventricular system. Subdural collections of air are very unusual. These are small since the subdural space is only potential and considerable pressures are required to expand it. Subarachnoid filling must be accomplished by a break in the membranes in one of the cisterna.

Most cases of pneumocephalus are the results of fractures that pass through the frontal or paranasal sinuses. In these regions the dura is thin and adherent, so that it is easily split. Occasionally breaks in the region of the middle ear and mastoid cells may allow air to escape inside the head. Gunshot wounds, compound fractures, and stab wounds, especially in the occipital region, may produce a fistulous opening, producing pneumocephalus. Besides trauma, ostemas of the skull, syphilis, tuberculosis, and cancer may erode the coverings of the brain. Mild trauma under these circumstances may produce a fistula.

A case in which gas was demonstrated in the orbit and frontal lobe following a puncture wound of the lid by a lead pencil was reported by Slaughter and Alvis.[55] The "lead" apparently was pushed through the orbital roof into the frontal lobe. An orbital abscess followed which was drained with eventual complete recovery. The gas may have been air, or may have been generated by the bacteria producing the abscess.

Courville[56] remarked that the intracranial collections of gas are air less oxygen, since the latter is rapidly absorbed. He also stressed the necessity of having a loose flap of dura producing a valvelike action to trap the air inside the skull.

Symptoms may be present almost immediately following the trauma or may be delayed for months. The reason for the latter is not clear, but since basal skull fractures are very slow to heal, a sudden increase of

intraoral pressure during sneezing, coughing, and so forth, may rupture the overlying meninges and allow the ingress of air.

The complaints of the patient may be mild. Often there may only be a complaint of a "swishing or sloshing" noise in the head. This is almost characteristic of air in the ventricular system. On the other hand, there may be symptoms of increased intracranial pressure, with severe headache, dizziness, nausea, vomiting, hyperthermia, and unconsciousness. If the pressure is prolonged, papilledema develops.

The pressure may be constant or spasmodic. In the latter instances, the temporary rises are brought about by coughing, sneezing, straining, and so forth, and are undoubtedly due to the ball-valve action of the tissues in the fistula. There is severe head and face pain in sneezing, sudden nausea, and even temporary lapses of consciousness.

The diagnosis is usually easy to make. Evaluation of the patient's story of sudden pain and swishing noises in the head are sufficient. Patients with intermittent rhinorrhea are very good candidates for pneumocephalus. X-ray studies will demonstrate the presence of gas inside the skull, and spontaneous ventriculograms have been noted frequently.[57]

Treatment should be conservative in the beginning. The patient should be put at rest and observed. Penicillin and sulfonamides should be given prophylactically since meningitis or intracranial infections are real dangers. If a compound vault fracture is present, it should be treated in the usual manner. Most of the cases are benign and the fistulas soon close. The gas is then rapidly absorbed.

Occasionally symptoms remain, or those of increased pressure progress. In these cases surgery is indicated. The tear in the dura should be closed, with a graft if necessary. The skull fracture may be treated at the same time, by elevation of a depression, removal of loose fragments, and so forth. Treatment should not be long delayed in cases of intracortical aeroceles as persistent pressure may cause considerable cortical damage.

The end results are usually good especially if chemotherapy is started promptly and if operation is not long delayed in cases that do not show rapid absorption of the air.

Subcutaneous emphysema

Air may be forced into the subcutaneous tissues in large amounts following puncture wounds of the chest. There is probably a bellowslike action of the lungs which forces air into subcutaneous tissues through a fistula that has a ball-valve action. Once into the loose subcutaneous tissue, there is almost no limit to where the air may dissect. It is restrained only by the tough attachment of the skin in the palm of the hands and soles of the feet, and by the galea at the edges of the skull. We have seen a patient who within two hours following a closed injury to the chest that produced several fractured ribs, had subcutaneous collections of air over the entire body except the finger and toe tips and the scalp. The eyelids were so full of air that the eyes were swollen shut.

Besides chest wounds, generalized emphysema may follow the puncture of almost any air-containing viscus. Tracheotomy and operation in the nasopharynx may allow the egress of air into the subcutaneous spaces. Brown and Hinton[58] report an instance following the operative resection of the large bowel. They mention cases following rupture of a peptic ulcer and a perforated sigmoid diverticulum.

Localized emphysema of the orbit may follow tooth extractions or operations in the paranasal sinuses. In both these cases the continuity of bone is broken and air is forced into the orbit. Linhart[59] has reported several cases following trauma about the nose or eye. Often this is mild, and not infrequently follows falls or boxing. We have seen it following stab and gun wounds about the eye, also after therapeutic injections about the eye and in the nose.

Air readily finds its way into the orbit when the lamina papyracea of the ethmoid is fractured. Increased intranasal pressure, as produced by sneezing and coughing, forcibly propels more air through the fracture. Thus air reaches the eyelids and the air is behind the septum orbitale.

In such cases, there is a unique combination of signs: proptosis and narrowing of the palpebral fissure. Emphysema of the lids with the air in front of the septum orbitale does not produce exophthalmos or pronounced narrowing of the palpebral fissure.[60]

The diagnosis of subcutaneous emphysema is not difficult to make. The soft swelling of the tissues, with crepitation that can be felt and heard, leaves no doubt about the presence of gas. Both in the generalized and orbital cases, there is usually a history of trauma or operation. X-ray studies of the orbit will demonstrate the air clearly, but fractures of bone are almost never seen.

It is of importance to realize that the firm attachment of the galea limits the upward direction of the air. As pointed out in the section on pneumocephalus, extracranial aeroceles are limited by the attachment of the galea and therefore do not involve the lids and orbit. Likewise air coming from below this attachment will involve the eyes but will not go into the scalp. If both are found two lesions must be present.

Gas gangrene is the only condition that may be confusing. However, patients with this condition do not show the rapid advance of gas in the subcutaneous tissues. In traumatic cases, the symptoms begin at once but, in gas gangrene, there is a delay of hours or days. Also the local condition of the wound, fever, tachycardia, pain, and cerebral signs of intoxication charasteristic of gas gangrene are missing in cases of subcutaneous emphysema.

Treatment is conservative, as far as the emphysema is concerned. Penicillin and sulfonamides should be administered to prevent infection. In the generalized cases, the swelling of the lids usually subsides within 72 hours, while in the localized orbital cases all get well within a week.

Diagnostic principles and treatment of acute head injuries

Only the broadest principles can be mentioned here. Patients in shock should be treated for such at once. Then a history should be obtained. Since many patients are unconscious, this may have to be obtained from relatives, witnesses, or police. The type of injury received may be the largest clue as to what is going on inside the head.

The physical and neurologic examinations should be as thorough as possible. The results should be recorded, as changing signs, especially in the state of consciousness, are of the greatest importance. Associated injuries may need prompt attention and should not be overlooked.

It is rare that acute injuries require immediate operation. Since most patients will require careful watching, nurses properly trained are essential. Frequent determination of the temperature, pulse, respiration, and blood pressure are noted. The state of consciousness is most important and any changes should be noted and evaluated. The surgeon should often check on this point himself. The appearance or disappearance of neurologic signs should be watched for and recorded.

Besides these things, the unconscious patient needs constant attention to see that vomitus is not aspirated; that his temperature is controlled, either by keeping him warm if the temperature is subnormal; or by cooling him by fans, ice sponges, and so forth, if it goes about 104°C. An adequate airway must be maintained. An unconscious patient who has difficulty breathing should be suctioned frequently, an anesthesia airway inserted and, if necessary, intubated. Bladder catheterization may be necessary and the bladder should not be allowed to become overdistended.

Certain neurologic signs and symptoms, if present, or if they appear under observation,

require careful consideration since they may signify that a collection of blood of surgical importance may be forming. A steadily deepening unconsciousness, especially after a lucid interval, is very important. A prolonged period of unconsciousness without signs of rousing may be equally significant.

Anisocoria with a sluggish or fixed pupil very commonly means that a large hematoma has formed. This sign may be transient but that does not lessen its importance. The onset of facial convulsions later spreading to arm and leg is a sign of local irritation and often means that an extradural hematoma is present.

Generalized convulsions, especially in children, do not carry the same import. Usually they are produced by a local cortical laceration or blood in the subarachnoid space. "Tonic" or cerebellar fits mean brain-stem injury or compression and carry a grave prognosis. Not infrequently large subdural hematomas producing great increase of intracranial pressure account for this type of convulsion.

The onset of a hemiparesis, sometimes only evident in the face, or the appearance of unilateral clonus and the Babinski sign, may be of surgical importance when they occur in the presence of other symptoms indicating a rapidly rising intracranial pressure.

The respiratory rhythm is often a valuable guide to the state of intracranial compensation. A falling rate usually means increasing pressure. However, an irregular rate, with beginning cyanosis, retraction of the chest, and a honking noise due to a relaxed soft palate means that the medullary centers are becoming embarrassed. Occasionally this is the only sign of failing compensation, and we have seen several instances when this has been due to massive acute subdural hematomas. Diagnostic trephinations should be done promptly in the absence of other signs.

X-ray examinations have little importance in the immediate treatment of acute injuries. Most depressed fractures may be palpated. The presence of linear fractures may increase one's suspicion that a hemorrhage of surgical significance is present, but operation should neither be delayed because of its absence nor rushed because of this finding. Before depressed and compound fractures and gunshot wounds are subjected to operation, an adequate X-ray examination of the head should be carried out.

The value of diagnostic lumbar punctures is open to question unless infection is suspected. The presence or absence of blood is of academic value, and the pressures are not reliable guides.

Diagnostic trephinations should be used freely in cases of doubt. They may be done under local anesthesia and carry no risk. Openings should be large enough to inspect the dura and cortex thoroughly. A small crown trephine makes excellent inspection holes. Openings should always be multiple and bilateral. Four holes in each side of the head are usually adequate, two about 2 to 3 cm. from the midline; one in the frontal and one in the parietal regions, and two in the temporal region; one in front and the other behind the ear. The ventricular system may be tapped at the same time and the fluid studied. The hemispheres may also be explored with a needle for intracerebral hematomas.

Ventriculograms, encephalograms, and arteriograms may be necessary in chronic cases. Their use during the acute stages of a head injury is not recommended.

Treatment is divided into operative and nonoperative. The bulk of cases falls into the latter classification. Rest, adequate fluids, chemotherapy and antibiotics, and mild sedatives are used. We have had no experience with the regimens of dehydration and repeated lumbar punctures and have not been impressed by the statistics cited by others. Convulsions are controlled with phenobarbital and intramuscular magnesium sulfate.

Operations are reserved for compound

and depressed fractures and hematomas. Compound fractures of the vault should be thoroughly debrided, cortical bleeding controlled, the dura repaired, and the scalp closed. This should be done as soon as shock has been controlled. The same holds true for gunshot and other penetrating wounds of the skull.

Depressed fractures should be elevated promptly. Although the bulk of the cortical damage is sustained at the time of injury, if the condition is not relieved, additional damage may be sustained during the period of edema and later during scar formation. While some neurosurgeons disagree on the necessity for elevation of all depressed fractures, especially those over "silent" areas, the risk involved is so slight it seems all should be repaired as soon as the shock has been controlled.

Linear cracks need no special care, other than that outlined above. When the fracture has passed through the ear or a sinus, the liberal use of antibiotics and chemotherapy is indicated until all drainage has stopped and healing has been completed.

Extradural hematomas when located should be evacuated promptly and the bleeding controlled. Most of these hemorrhages are produced by rupture of the middle meningeal artery. In every case this vessel should be located and traced to the foramen spinosum to be sure that it has not been torn. If the hematoma is evacuated promptly the prognosis is excellent. Frequently, the symptoms disappear within a matter of a few minutes. However, if operation is delayed, pressure on the vital centers may be so severe that unconsciousness persists for days and severe permanent cortical damage results. At times, death ensues despite the relief from pressure.

Subdural hematomas present a somewhat different problem. In the thin acute type, simple irrigation through burr holes is sufficient. If the hemorrhage is massive, it may be well to enlarge one of the openings sufficiently so that the hemorrhage can be thoroughly and quickly evacuated. Any bleeding from torn cortical vessels can be stopped with the cautery at the same time.

Chronic subdural hematomas on the other hand often present a more difficult problem. These, too, can sometimes be evacuated through burr holes and the membranes allowed to absorb. The process may have to be repeated several times. A better method is to turn down a small flap so that the blood can be entirely removed. The outer membrane need not be stripped completely but the incised edges should be carefully cauterized to prevent oozing. Rarely can the inner membrane be stripped completely, and this should not be attempted if it is adherent to the cortex.

The hematomas in infancy can sometimes be cured by multiple aspirations through the open fontanel or by a burr hole placed beneath the temporal muscle. However, if fluid continues to reaccumulate after 3 or 4 taps, or if membranes are present, a small bony flap has proved satisfactory for the complete removal of the hematoma and at least part of the membrane.

Subarachnoid hemorrhages should be treated conservatively. The nuchal rigidity and fever produced by the blood may lead to confusion with meningitis. A diagnostic lumbar puncture will clear up this difficulty. Repeated drainage of the cerebrospinal fluid in an effort to draw off the blood has not seemed worth while.

Intracerebral hematomas of significant size are rare. If they present symptoms, they should be tapped and the blood drawn off.

Recently, some authors have advocated total removal of badly lacerated temporal and frontal lobes shortly after the injury. They point out that an internal decompression is obtained, and that convalescence is shortened by the removal of the mass of necrotic tissue. This seems a rather heroic measure, and in our hands has not been very successful.

In summary, operative intervention is only occasionally required in the treatment of head injuries, and is directed toward the evacuation of collections of blood and the repair of compound fractures. Subtemporal decompressions for increased intracranial pressure have questionable value.

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SOME OBSERVATIONS ON MIOTICS*

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The fact that so many different miotics are in use is perhaps an indication that the ideal one has not yet been found. During the past 15 years, tremendous strides have been made in our knowledge of the pharmacodynamics of the intraocular muscles, but there are still many gaps in our understanding of how miotics act and why they sometimes succeed in controlling increased intraocular pressure and more often fail to do so.

Therefore, it may be worth while to evaluate some of the miotics currently used, beginning with a brief review of the pharmacologic background.

PHARMACOLOGIC BACKGROUND

Although the possibility that chemical substances might mediate nerve impulses was suggested as far back as 1877 by Dubois-Reymond,[1] it was not until 1914 that Dale[2] brought forward his theory of the parasympathomimetic action of acetylcholine on the autonomic nervous system, and postulated the existence of an esterase to account for its brief duration and its breaking down into acetic acid and choline.

The classic experiments of Loewe[3] in 1921-1922 established the first proof of the release of chemical agents by nerve impulses and the fact that these substances act on smooth muscle causing it to contract. Due to the work of Feldberg,[4] Dale,[5] Chang and Gaddum,[6] and others it has become accepted that stimulation of parasympathetic nerves causes the liberation of acetylcholine at the myoneural junction. In similar fashion most sympathetic nerves act through the medium of epinephrine, the notable exception being those to the sweat glands.

The theory of nerve impulses being transmitted by acetylcholine at the myoneural junctions has been challenged recently by Nachmanson,[7] who suggests that this substance is responsible only for conduction. However, his views have not received universal acceptance.

Englehart,[8] in 1931, showed that impulses, passing along the short ciliary nerves, liberated a substance in the aqueous which had the properties of acetylcholine. This was absent when the ciliary ganglion had been removed beforehand. It was found to be greatly increased when the eye had been previously exposed to light, but it was absent in the dark-adapted eye, even after eserine had been instilled to destroy the cholinesterase.

The present belief is that acetylcholine exists in the tissues in an inactive, nondiffusible form. The nerve impulse changes this to an active and diffusible form which acts immediately on the hypothetical effector cell, but is thereupon quickly destroyed by cholinesterase. The inactive form persists as long as parasympathetic nerves remain intact.

The ciliary body has plenty of it except when the postganglionic fibers are cut. As the nerves degenerate, the acetylcholine disappears from the tissues but, as Cannon[9] has shown, the cells formerly innervated by the parasympathetic fibers then become abnormally sensitive to acetylcholine. This increased sensitivity to acetylcholine can develop within 24 hours. Its mechanism is not clearly understood.

CLASSIFICATION OF MIOTICS

We may divide miotics into two broad groups:† (1) Those which act directly on the effector cell in the iris muscle, and (2) those which act passively by inactivating or de-

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† Since this paper was written a new group of miotics which block sympathetic stimulation adrenergic receptors has been introduced into ophthalmology by Christianson and Swan.

stroying cholinesterase and thus permitting the unregulated production of acetylcholine which stimulates the effector cell to activity.

Those in the first group are, for the most part, drugs closely related to acetylcholine, and merely supplement the normal stimulation which this chemical gives to the sphincter muscle of the iris. They are mecholyl, charcolin, and furmethide. Pilocarpine, an alkaloid, acts in similar fashion, and, like the others, is effective after nerve section and complete degeneration. Histamine also acts directly on the muscle and is a very powerful miotic, but it causes too much irritation to be of practical value.

The second group, which destroys cholinesterase and thus allows the uncontrolled production of acetylcholine, is probably the most powerful but not necessarily the most desirable. Examples of this group are eserine, neostigmine, the fluorophosphates, and a relatively new compound, tetraethyl pyrophosphate.

Miotics may be discussed under three main headings. (1) Their effect on the musculature of the iris and ciliary body. (2) Their effect on the vascular supply of the anterior segment and on the blood-aqueous barrier. (3) Their effect on the intraocular pressure.

I. Effect on musculature of iris and ciliary body

In general, any miotic, when dropped into the conjunctival sac, affects the iris sooner than the ciliary body, probably because it reaches the iris first and in higher concentrations. Thus miosis begins before any spasm of accommodation takes place.

The degree of miosis and accommodative spasm depends entirely on the intraocular concentration of the drug and the individual quantitative response. Some miotics produce relatively more cyclotonia in relation to miosis than others. We must always remember in comparing one miotic with another that usually the same degree of miosis can be accomplished by either, provided an adequate concentration is brought to bear on the iris.

Factors affecting the intraocular concentration are the size of the drop used, the vehicle emyployed, the method of instillation, the permeability of the corneal epithelium, the physical properties of the drug, and its relative affinity for water or fat. With so many variables it is obvious that direct comparisons of one miotic with another must be carefully controlled to have any value.

The following observations on the various miotics are based on my own experience, and that of others.

Pilocarpine. The miosis produced by 1-percent to 2-percent pilocarpine is prompt and efficient, but lasts only for a day. In these same concentrations, pilocarpine usually causes a slight, but not unpleasant, stimulation of the ciliary muscle, and this fact has been made use of by some ophthalmologists in recommending the use of 0.25-percent solution before reading for certain young asthenopes with subnormal accommodation. I have found this useful on occasions.

However, certain individuals may react rather violently to pilocarpine, as little as 0.5-percent solution causing a marked miosis and ciliary spasm, but these are exceptions. On the whole I feel it is the most satisfactory miotic and can be used in much higher concentrations than was formerly thought possible.

For maximal miosis in glaucoma a 4-percent solution is frequently employed, and it can be used as high as 10 percent if the HCl salt rather than the nitrate is employed, since the former has greater solubility. The pH must be kept at 5 to 6 to avoid precipitation of the alkaloid. Long-continued use, even in moderate concentrations, occasionally causes a follicular conjunctivitis and the production of pigment synechias, but in my experience this is extremely rare. Pilocarpine is superior to eserine in this respect.

Acetylbetamethylcholine (mecholyl) is

poorly absorbed through the cornea and has very little effect on the normal pupil in anything less than 15-percent solution. I have attempted to remedy this by the addition of zephiran (1:3,000 solution) as a wetting agent, but without success. However, as Adler[10] has pointed out, the situation is different in a glaucomatous eye with high tension, where a 10-percent solution will constrict the pupil readily.

This apparent sensitivity to mecholyl in glaucoma is interesting. It may be that the choline esterases are interfered with in this disease as suggested by Friedenwald[11] and hence mecholyl is more effective than in normal eyes. Swan's[12] explanation is that the corneal-epithelial barrier is disturbed in cases with elevated tension and this enhances absorption.

Adler and Scheie[13] found that, although mecholyl in less than 15-percent solution had no effect on the normal pupil, a 2.5-percent solution sharply constricted the tonic pupil of Adie's syndrome. From this observation and from experimental work on cats, they concluded that the site of the lesion in tonic pupils is in the third nerve somewhere between the ciliary ganglion and the nerve endings in the sphincter muscle, and that the lesion partially destroys these fibers. Hence the pupil becomes permanently sensitized to acetylcholine and will respond to small concentrations of mecholyl which ordinarily would have no effect.

It has been my experience that in the dilated atrophied pupil of an old blind, glaucomatous eye, a 10-percent mecholyl solution will constrict the pupil moderately; whereas, in the dilated pupil of a complete third-nerve paralysis the same drug will have no effect. In the former case there has been damage to the postganglionic nerve-fiber endings in the sphincter muscle with some sensitization, but, in the latter, the preganglionic fibers are probably involved, hence no sensitization.

In glaucomatous eyes mecholyl usually causes more stimulation of accommodation than pilocarpine, but not as much as some of the other miotics. Since this drug is partially destroyed by cholinesterase upon reaching the aqueous, its action is brief, the miosis persisting for two hours only. Therefore, for practical purposes it should be used with one of the cholinesterase inhibitors, usually neostigmine.

A word of warning should be given on the use of mecholyl by retrobulbar injection, a method occasionally employed in acute glaucoma and in cases of sudden obstruction of the central retinal artery. I have seen three near-fatalities by this method of administration. Although the dose in each case was considered a perfectly safe one, the patients reacted very badly to it, going into circulatory collapse. It should never be given subconjunctivally unless there is, ready and waiting, a sterile syringe containing 1/100 gr. atropine. Mecholyl by injection is also contraindicated in asthmatics for fear of bronchial constriction.

Carbaminoylcholine (carcholin). This drug, formerly called Doryl, is another choline ester which is probably the most toxic and the most potent of the group. It has the advantage of not being destroyed by cholinesterase. Its miotic action is therefore prolonged, provided it is properly administered.

O'Brien and Swan[12] brought out the important fact that this drug is poorly absorbed through the cornea. Carcholin is of low surface-tension activity with high affinity for water, and low lipoid affinity—such drugs are poorly absorbed in aqueous solution since they tend to remain in their vehicle.[14] O'Brien and Swan[12] recommended the instillation of 1.5-percent solution of carcholin in an aqueous solution of zephiran (1:3,000) which reduces the surface tension of the cornea, possibly injures the corneal epithelium, and thereby enhances absorption.

In a more recent communication Swan[15] found that 1.5-percent suspension in anhydrous petrolatum penetrated best of all. By

this method carcholin has a relatively higher affinity for the corneal epithelial barrier than for its vehicle, and therefore passes through readily.

The accommodation is definitely stimulated by carcholin, O'Brien and Swan[12] finding an average of 1.18 diopters of false myopia produced by one drop of the above concentration as compared to an average of 0.5 diopter produced by 2-percent pilocarpine.

Furfuryltrimethylammonium iodide (furmethide) is a fairly recent drug, which is a strong parasympathetic stimulator, and which is not destroyed by cholinesterase. When used in 10-percent solution, its miotic action is prompt and it produces a moderate degree of cyclotonia. According to Owens and Woods,[16] it is more effective than mecholyl and prostigmin in acute primary glaucoma, especially in late cases, and is slightly more effective than pilocarpine (2 percent) in chronic primary glaucoma. Although I have not made any critical comparisons of this drug with other miotics, my impression is that it possesses no special virtues over 2-percent pilocarpine, and, furthermore, it often causes more blurring of vision than the latter.

The second group of miotics consists of the anticholinesterase drugs.

Physostigmine (eserine) is probably the best known of these, although neostigmine, a synthetic alkaloid, has practically identical qualitative actions so that the two drugs may be considered together. In addition to rapid and intense miosis, they often cause a severe accommodative spasm. After their use, the accommodation remains in a hyperexcitable state for many hours. Long continued use of eserine may cause a follicular conjunctivitis. I have not observed this with neostigmine.

Eserine has a tendency to take on a pink color due to oxidation. To delay this the pH should be adjusted to 4 to 5. Many patients complain of smarting following instillation. The irritating quality of this drug must be due to something intrinsic since the degree of irritation usually bears a direct relation to the concentration irrespective of the pH. It is usually employed in 0.25- to 0.5-percent solutions. Neostigmine, which is much less irritating, is used in 3-percent or 5-percent solution.

Di-isopropyl fluorophosphate (D.F.P.) Leopold and Comroe,[17, 18] and McDonald[19] have determined the effects of this interesting compound on normal and glaucomatous eyes.

D.F.P. is a very powerful miotic and has many undoubted advantages. Its prolonged action obviates the necessity of frequent instillations, and sensitivity is extremely rare. However, the unpleasant symptoms from the strong cyclotonia preclude its use in many patients. Detachment of the retina[20] and activation of a quiescent uveitis[21] have been ascribed to it, although personally I have not encountered such complications.

In spite of its unpredictability, I have found it most successful in cases of glaucoma associated with aphakia and I believe it to be the drug of choice in these cases. This does not mean that all aphakic cases are successfully controlled by it since many factors are involved.

It is an interesting fact that the unpleasant symptoms of ciliary spasm and congestion of the eyeball frequently seen after D.F.P. instillation are usually absent or minimal in cases of aphakic glaucoma. Leopold and Comroe[17] have advanced a theory to account for the lack of ciliary spasm. They suggest that a lens with intact zonular fibers must be present for the pain of ciliary spasm to develop. However, this would not account for the lack of vasodilatation in these cases.

The following theory might explain the absence of both factors. The vitreous is known to be very rich in cholinesterase. Brückner[22] has shown that in certain animal eyes its concentration is four times greater in the vitreous than in the aqueous. Following cataract extraction, the barrier between the posterior chamber and the vitreous is

usually disrupted and the vitreous often bulges forward into the anterior chamber.

Thus, it is possible that, in aphakics, there is so much cholinesterase present in the aqueous that it is not all destroyed by the one drop of D.F.P. usually instilled. If so, the remainder might exert some control on the acetylcholine formation and thus the whole effect of D.F.P. would be tempered down with a consequent reduction of the unpleasant symptoms.

Tetraethyl pyrophosphate (T.E.P.) is a colorless liquid of low volatility which is the active ingredient of the insecticide hexaethyl tetraphosphate which was used in Germany during the recent war. T.E.P. is highly toxic and produces marked miosis in animals and man. Pharmacologic studies have shown that it is a very efficient inhibitor of cholinesterase, being more effective in this respect than either D.F.P. or eserine. It is even more unstable than D.F.P. and, like the latter, must be dispensed in peanut oil.

The miotic and antiglaucoma activity of T.E.P. has been investigated by Grant[23] of the Howe Laboratory of Ophthalmology. His studies indicate that in normal human eyes T.E.P., 0.1-percent solution in peanut oil, produces rapid miosis (in 7 minutes), spasm of accommodation, eye pain, and brow ache. The accommodation returns to normal after 4 days, but a relative miosis may persist for 2 to 3 weeks with a progressive relaxation as the days go by. In some of the eyes a slight transient engorgement of the conjunctival vessels occurs. There is no local discomfort at the time the drops are used, and slitlamp examination shows no evidence of damage to the corneal epithelium. In no instance have systemic symptoms been noted.

Grant has studied the effects of T.E.P. on 15 patients with chronic primary or secondary glaucoma. In most instances T.E.P. did not reduce the tension in eyes in which it could not be reduced by other miotics. There were 1 or 2 exceptions, but in general this was true.

II. Effect on the vascular supply of the anterior segment of the eye and on the blood-aqueous barrier

It is well known that after the instillation of certain miotics the conjunctival and ciliary vessels may become engorged. This is characteristic of the derivatives of acetylcholine, such as mecholyl and carcholin, which cause it quickly, and even more characteristic of the anticholinesterase drugs, particularly D.F.P., in which the congestive action is delayed.

In the case of D.F.P., engorgement of the iris vessels may occur, as I have often observed by slitlamp examination. I have not noted this to the same degree with other miotics. This is sometimes accompanied by the appearance of cells in the aqueous when 0.2-percent solution is used. There is never any tendency to formation of posterior synechias. It is an interesting fact that these congestive features never appear until 10 to 24 hours after instillation of the drug. They can, of course, be eliminated by atropine which blocks the action of acetylcholine on the effector cell.

This delay in the appearance of the vasodilator effects is difficult to explain. Perhaps the accumulated acetylcholine cannot be absorbed by the tissues and thus causes vasodilation, first of the iris vessels, with the congestion gradually spreading to the anterior ciliary and the conjunctival vessels. All these congestive features usually disappear in 2 or 3 days as the eye becomes accustomed to the drug.

There is considerable evidence to prove that most miotics have a profound effect on the blood-aqueous barrier, and on the osmotic pressure of the aqueous.

Swan and Hart[24] showed that, in rabbits, instillations of mecholyl, carcholin, and eserine all caused a significant increase of the protein content of the aqueous. Pilocarpine did not. Studies with intravenous inulin, a large molecule polysaccharide, demonstrated that this substance, which does not ordinarily pass the blood-aqueous barrier

in rabbits, passed freely into the aqueous after instillations of eserine, carcholin, and mecholyl, but not after pilocarpine. Similar studies made with intravenous dyes such as sodium fluorescein showed that after eserine, carcholin, or mecholyl instillations, the dye appeared in the anterior chamber 4 to 8 minutes before it appeared in the control eye.

More recent experimental work by Leopold and Comroe,[18] by Scholz,[23] and by von Sallmann[26] indicates that D.F.P. also produces a marked change in capillary permeability to flourescein and a definite increase of protein in the aqueous. This change in the permeability of the blood-aqueous barrier is probably of marked significance in changes in the intraocular pressure.[27]

III. Effect on intraocular pressure

It has long been felt that miosis is not the only factor which reduces the tension of the eyeball, since the miotic drugs have been known to accomplish this in cases in which the iris angle appears gonioscopically to be completely blocked by adhesions and even in cases of complete aniridia. Therefore, other possibilities must be considered.

The vasodilator effect which all miotics possess to a greater or less degree is probably a most important one. Because of this vasodilator factor intraocular pressure tends to rise slightly after instillation followed by a fall as the other factors become operative.

This was shown years ago by Wessely[28] who noted that eserine dropped into a rabbit's eye gave a marked dilatation of the vessels of the iris and ciliary body, also that the protein in the aqueous was increased and that entrance of intravenous fluorescein into the anterior chamber was facilitated. Eserine also caused an increased tension in rabbits a few minutes after the pupil had become miotic. This lasted 15 minutes, dropping back to normal and then becoming subnormal.

Clinically, we see certain cases of glaucoma in which the tension rises following the use of miotics and remains elevated. I have seen it occur once after eserine, 6 times following D.F.P., and once with T.E.P. I have never seen it following pilocarpine. It has been reported rarely with carcholin and with mecholyl.

Let us consider the various possible factors which might tend either to reduce or increase the introcular pressure following the instillation of miotics.

Action of miotics

Factors tending to reduce tension	*Factors tending to increase tension*
1. Mechanical freeing of the angle.	1. Vasodilatation of iris and ciliary body with increase in their volume.
2. Contraction of longitudinal fibers of ciliary muscle on the scleral spur, opening up Schlemm's canal.	2. Cyclotonia causing lens to push iris root forward.
3. Reduction of blood flow to ciliary processes by ciliary spasm.	
4. Changes in permeability of blood aqueous barrier and the iris vessels.	

It can be seen that the action of miotics on the intraocular pressure is a complex one and represents a struggle between antagonistic forces. Sugar[29] has suggested the use of a vasoconstrictor drug, such as neosynephrin (1 percent), along with the miotic as a logical means of combating excessive vasodilatation and cyclotonia, and thus insuring a predominance of the pressure-reducing effects. He advises this only in shallow-angle glaucomas, and in acute congestive attacks, to reduce the chances of inadvertently raising the pressure.

In the six cases in which I have observed a rise of tension after D.F.P., and the one in which this occurred following T.E.P., all the eyes had very shallow chambers. I, therefore, have been following the advice of Sugar in all cases of shallow-chamber glaucoma whenever D.F.P. is used, and have used neosynephrin (1 percent) along with it.

Kronfeld,[30] a few years ago, attempted to correlate the responsiveness to miotics with the gonioscopic findings in various types of glaucoma. His conclusions were that:

1. In shallow-angle glaucoma, both in the

chronic and in the congestive phase, miotics were successful if not more than three-fourths of the angle was closed off by synechias.

2. In glaucoma associated with delayed reformation of the anterior chamber, miotics were often successful in reducing the pressure, provided the peripheral anterior synechias were filamentous in nature and not too solid.

3. In glaucoma associated with exfoliation of the lens capsule, miotics were notoriously inefficient.

In all other types of glaucoma no correlation was found.

In my own experience, very little correlation exists between the gonioscopic picture and the response to miotics in any type of glaucoma, the possible exception being that associated with exfoliation of the lens capsule. This type is seldom controlled by miotics. Even in the shallow-angle, iris-block type with few synechias, there are many cases that will not respond. In some patients both angles will look exactly the same, yet one eye will respond to miotics and the other will not. There are too many other factors beside the miosis to permit correlation.

What, then, is the value of miotics in the treatment of glaucoma?

1. Certainly in acute congestive attacks they are of inestimable value in bringing the tension under control before surgery is attempted.

2. In chronic simple glaucoma a few patients may be carried along successfully for years on miotics alone. I think this is rare, but perfectly possible, in both the shallow-angle and the wide-angle types, if treatment is instituted early.

3. They are often very helpful after operations which are only partially successful.

4. They are indicated after cyclodialysis as an aid in maintaining an open cleft.

Their danger lies in our placing too much reliance on them. Patients are apt to grow careless in using them and, therefore, should be frequently observed if on a miotic regime. In most instances the beneficial effects of miotics are not sufficiently prolonged to postpone surgery indefinitely.

Discussion

When all is said and done, an ophthalmologist's choice of a miotic is based on his own experience. Without wishing to appear too dogmatic I would like to state what my experience has been. In acute glaucoma I want to use a drug that will bring the tension under control quickly. For this I usually employ the synergistic combination of mecholyl (20 percent) and neostigmine (5 percent) every 15 minutes for an hour or two, until the tension comes down to normal, and surgery can be performed. Equally good results may be accomplished by similar use of a combination of pilocarpine (4 percent) and eserine (0.5 percent). I am a little fearful of D.F.P. in these acute congestive cases.

In chronic simple glaucoma I depend on pilocarpine (1-percent to 4-percent solution, 2 to 4 times daily) to control the pressure. If this is ineffective, I usually suggest operation and waste no more time with other miotics, particularly when the patient shows well-defined field changes.

There are exceptions of course. A patient on whom surgery is contraindicated for any reason, or one on whom surgery has been performed without complete success, deserves further trial with some other miotic. In these instances I may try the combination of pilocarpine and neostigmine, or D.F.P. (0.05 percent) solution. In using the latter I combine it with 1-percent neosynephrin in all cases with shallow angles.

I have found carcholin (1.5-percent suspension in anhydrous petrolatum) valuable in patients who develop sensitivity to other drugs.

In glaucoma associated with aphakia, I use D.F.P. (0.1 percent) solution as my first choice. I may use adrenalin borate (2 percent), particularly if the pupil appears blocked by vitreous.

In glaucoma secondary to uveitis I do not use miotics in active stages, but treat the

patient with atropine and adrenalin borate. However, in mild chronic cases with white eyes and no tendency to synechias, I often use pilocarpine. In old cases with the iris plastered to the lens, pilocarpine may be helpful. I am inclined to avoid strong vasodilating drugs in glaucoma secondary to uveitis.

In glaucoma associated with exfoliation of lens capsule, in hemorrhagic glaucoma, and in buphthalmos, I spend little or no time using miotics, but proceed to other measures.

Conclusions

1. In spite of an enormous amount of work done on the subject we are still not certain just how miotics lower the tension. Clinical experience and experimental work suggest a combination of miosis and an opening up of the blood aqueous barrier with changes in the osmotic relationship.

2. Some drugs produce more vasodilatation and cyclotonia than others, although their miotic effects may seem to be equal.

3. These vasodilatating and cyclotonic actions of miotics are probably of considerable importance in determining their effect on the intraocular pressure.

4. The combination of 1-percent neosynephrin with a miotic should be a rational procedure in glaucomatous eyes with shallow angles, especially when the miotic has strong vasodilating and cyclotonic actions.

5. Although we are learning more and more about the iris angle through gonioscopy, we are still not in a position to predict just what type of glaucoma will respond to miotics.

6. Generally speaking, miotics are valuable in early cases of both acute congestive and chronic simple glaucoma in bringing the tension under control while evaluating the patient for proper surgical procedure. They are also extremely helpful after operations which just miss being 100-percent successful. Although miotics alone may carry a few glaucoma patients along satisfactorily for years, they must be considered an adjunct to, rather than a substitute for, surgery.

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NASAL CONTRACTION OF VISUAL FIELDS IN GLAUCOMA

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Some of the factors which may contribute to the pathologic processes in glaucoma have not, as yet, been satisfactorily elucidated. One of these factors is the nasal contraction of the visual field which is, in my opinion, one of the important signs of this disease.

CIRCULATION THEORY

In many monographs, this phenomenon is explained by the theory of Arlt and Rydel.[1] Their theory, which seems to have more probability than others, is based on the fact that circulation of the blood is poorer in the temporal parts of the retina, since the vessels that go out of the optic-nerve disc to this region have a longer course than those which run to the nasal part. The temporal vessels describe a long circle, while the nasal ones go straight to the periphery.

Moreover, it must be remembered that the disc (the exit of the vessels and nerve fibers) is situated eccentrically at the nasal side and not in the center of the retina.

Wegner[2] found, when producing experimental anemia of the retina (pressing the eye), that the nasal half of the visual field disappears first, and only later, the temporal half. I could not confirm this phenomenon either in others or in myself. The visual field darkened equally on both sides and, as the pressure increased, suddenly ended in total blindness.

Another weak point in the circulation theory is the fact that macular vision is preserved for a long time after peripheral vision is impaired. Since both the macula and periphery depend for their nutrition on the small vessels, it would seem logical to assume that, if pressure exerted on the vessels was the exclusive decisive factor, macular and peripheral vision would be equally impaired.

One explanation offered for this difference in the rapidity of visual impairment is that, in the region of the macula, the vessels are deeper and are, therefore, better protected against pressure. Yet, one must consider the observations of Jacobson and Gamo Pinto[3] who found that the greatest loss of visual field corresponded to the deepest cupping of the opposite side of the disc.

Arguments against theory

There are a number of arguments that can be presented in refutation of the theory of Arlt and Rydel.[3]

1. In arteriosclerosis, the visual fields, unlike those in glaucoma, show a uniform contraction, although, in this disease, there is also disturbance of the circulation of small blood vessels.

2. Tangent-screen studies of visual fields in glaucoma always demonstrate that the loss of the visual fields is in connection with the blindspot. This would seem to indicate that the pathologic condition first affects the nerve fibers. It would seem logical to assume that, if pressure on the vessels was primary, the peripheral parts of the retina would be affected since it is they which suffer first from a circulatory disturbance. In this case, contraction of the visual field would proceed from the periphery and would have no connection with the blindspot.

3. The presence of an annular scotoma coming directly from the blindspot would seem to indicate that there is direct pressure on the nerve fibers.

4. In arteriosclerosis, atrophy of the retina and secondary atrophy of the optic nerve make a hollow cup of the disc that is easily distinguished from glaucomatous cupping.

Impairment of nerve fibers

Such arguments as have just been presented would tend to show that the contraction of the visual field is immediately connected with the impairment of the nerve fibers on the margin of the disc (and it is interesting to note in this connection that Arlt and Rydel[4] indicated that the temporal nerve fibers going out from the disc describe the same circle as the blood vessels).

Hydrostatic pressure

Appearance of disc

According to Fuchs,[5] excavation of the disc can be ascertained only by the curving of the vessels on the brim of the disc, because the nerve fibers are transparent and invisible.

However, if one studies the appearance of the disc during the period of already visible but not yet complete excavation, the cupping can be distinguished by the shadow cast by the overhanging brim. The disc itself has a grayish color, and the vessel trunk with all its capillaries is depressed on the nasal margin. Where the disc is not yet excavated, it has a rosy color.

Examination with the modern electric ophthalmoscope can also rule out the possibility that one margin of the disc is elevated. Such an examination gives the impression that the temporal portion is excavated to its edge, while in the nasal portion, the excavation does not reach the margin.

Fuchs[5] discussed this finding and acknowledged that even when cupping had taken place, nerve fibers remained on the nasal portion of the disc.

Anatomy of posterior region of eye

These facts would seem to establish the great probability that cupping of the disc begins on the temporal margin. In order to arrive at an explanation for this, it is necessary to have in mind the structure of the posterior region of the eye and particularly the course of the optic nerve and the place where it enters through the sclera.

The optic nerve enters the eye obliquely creating an acute angle with the nasal wall of the eye and an obtuse angle with the temporal part. This anatomic fact has significance in that it divides the internal pressure of the posterior wall of the eye.*

This pressure, which has a perpendicular direction, can be subdivided into two components: (1) that going along the nerve but not pressing on the nerve fibers (fig. 1A),

* It must be remarked that the interpretation herein presented depends upon the existence of a flow through the nerve. Really such a flow exists, although it is very slow. Therefore, the law of Dascel does not apply.

and (2) that going perpendicular to the nerve which presses the temporal nerve fibers against the margin of the disc (fig. 1B) and pushes the nasal nerve fibers away from the margin (fig. 1C). Physics teaches us that pressure in a curved pipe is greater on the convex than on the concave wall.

It can be justly remarked that, since the optic nerve is not a pipe, such an analogy cannot be made. This contradiction is, however, more apparent than real.

Fig. 1 (Arkin). Direction of the internal pressure of the posterior wall of the eye. (A) That going along the nerve but not pressing on the nerve fibers. (B) That going perpendicular to the nerve and pressing the temporal nerve fibers against the disc. (C) That pushing the nasal nerve fibers away from the margin.

Cupping of the Disc

The disc, as is known, is not a flat surface but has a small hollow known as the physiologic excavation. The physiologic excavation does not reach the margin of the disc, but it is always distinctly marked, being sometimes even in the shape of a funnel.

Glaucomatous cupping of the disc is the consequence of the enlarging and depressing of the physiologic excavation. How often in doubtful cases of glaucoma, when other symptoms are not sufficiently evident, does one seek diligently for any alteration in the physiologic excavation.

When intraocular pressure is pathologically increased, the two components of that pressure already described press immediately and with a distinct difference on the lateral walls of the physiologic excavation.

As soon as the physiologic excavation becomes a pathologic one, the difference in these two components of the intraocular pressure, following the laws of hydrostatics, constantly increases.

Anatomy of the Optic Nerve

One other factor must also be considered. When any portion of the optic nerve from the brim to some transversal section (fig. 2) is examined, it is seen that, because of the oblique course of the nerve, the length of

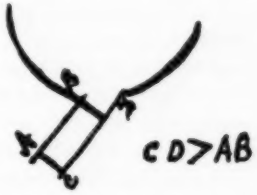

Fig. 2 (Arkin). A transversal section of the optic nerve shows that, because of the oblique course of the nerve, the length of the temporal part of the section is greater than the length of the nasal part.

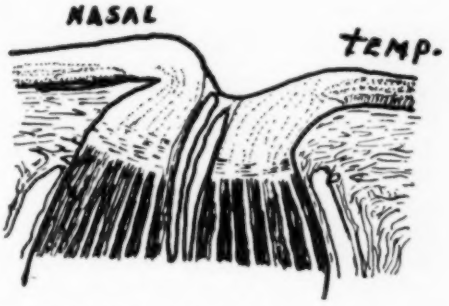

Fig. 3 (Arkin). The bulk of the nerve is greater on its nasal side (after Fuchs).

the temporal part of the section is greater than the length of the nasal part. It follows, therefore, that the bulk of the nerve is greater on its nasal side (fig. 3).

Arlt and Rydel[6] and Fuchs[7] made casual mention of these observations but gave no proper explanation for them.

It is in keeping with the laws of hydrostatics to postulate that a difference in the extent of nerve-fiber accumulation would produce a difference in the degree of resistance of the eye walls. The temporal wall, with fewer nerve fibers, would yield more quickly to increased intraocular pressure and would also show greater excavation than

the nasal wall. An automobile tire under excessive pressure always blows out on the convex side.

Anatomy of the vascular trunk

When one considers that the vascular trunk with all of its principal vessels is at the nasal wall of the excavated disc, it would seem to contradict the theory of a different pressure and different resistance on the nasal and temporal sides of the disc. This contradiction is only apparent, not real.

Thus far, only the difference in pressure on the lateral sides has been explained. But the vascular trunk has a central position. None of the vessels except the small macular ones pass over the temporal margin of the disc. Rather, the majority pass over the nasal, superior, or inferior, brim of the disc. When the tissue of the nerve becomes atrophic and hollow, the trunk bends in this direction.

Another factor that must be explained is why, in some cases, there is a contraction of only one-fourth of the visual field (notching of the visual field—symptom of Ronné).

Proponents of the circulation theory attempt to explain this by saying that it is because there is only one artery—superior or inferior. The "hydrostatic" theory herein advanced explains it by saying that it is due to the difference in the resistance of the upper temporal and lower temporal margins of the disc caused by a difference in their structure. Some authors have reported a difference between the size of the superior and inferior walls of the excavation.[3]

Finally, it is necessary to explain why the macular vision remains intact longer than the peripheral. The shorter course of the vascular and nerve supplies of the macula and therefore its better nutrition would seem to retard the decay of the macular vision. The same phenomenon is observed in optic-nerve atrophy deriving from other causes.

Conclusion

I admit that the theory herein presented is only an attempt, as is the blood-circulation theory, to explain the nasal contraction of the visual field in glaucoma, and it by no means excludes the circulation theory.

However, the circulation theory explains only one factor—that its poorer blood supply put an additional burden on the temporal part of the retina.

The theory I am presenting takes into account not only the existence of a different hydrostatic pressure but also the existence of a different degree of resistance on the nasal and temporal sides of the disc. It would seem, therefore, that the circulation theory and my "hydrostatic" theory complete each other.

Summary

The cause of nasal contraction of the visual field in glaucoma has never been satisfactorily explained. The best known theory is the blood-circulation theory.

I submit as additional considerations the oblique course of the optic nerve, which makes the length greater at the temporal part of the retina, and the consequent difference in the pressure acting on opposite sides of the physiologic or pathologic excavation, as well as the discrepancy in tissue resistance on the nasal and temporal margins of the disc.

Targowa Street, W. 15.

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CONGENITAL CATARACTS*

A SURVEY OF THE VARIOUS TYPES OF OPERATION

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There has always been some question as to the best method of removing congenital cataracts. To evaluate the various surgical procedures, we have studied the operations performed on 87 eyes with congenital cataracts. The operations were performed at the Wilmer Institute between October, 1943, and November, 1947, by the members of the full-time staff, the visiting staff, and the house staff. In all the cases the cataracts were present at birth or were noted shortly thereafter; the study includes both mature and immature cataracts. The average follow-up on the cases was 9.4 months. The longest period of observation was 4 years.

Similar statistical studies have been made by Horay,[1] Klare,[2] Kiss,[3] Chechik-Kunina,[4] Falls,[5] Owens and Hughes.[6] Owens and Hughes surveyed the operations on congenital cataracts performed at the Wilmer Institute between 1925 and October, 1943. Our data have been analyzed similarly to the method used by Owens and Hughes. This was done so that comparisons can be made of the results in the more recent years with the results in earlier years. The cases were analyzed to determine what effect the preoperative and operative factors had on (1) the final visual outcome, and (2) the occurrence of postoperative complications.

ASSOCIATED OCULAR DEFECTS

The first preoperative factor to be considered was the presence or absence of associated ocular defects. In 32 eyes (36.8 percent) the congenital cataracts were associated with other ocular defects, such as nystagmus, microphthalmos, strabismus, and congenital coloboma of the uveal tract. When strabismus was considered a congenital defect, the operation had been performed on the nonfixating eye.

Table 1 shows the occurrence of these various congenital defects in our group of cases. It was found that the presence of associated ocular defects was the most important factor in determining the final visual outcome.

TABLE 1

OCULAR DEFECTS ASSOCIATED WITH CONGENITAL CATARACTS

Nystagmus	9
Strabismus	9
Microphthalmos	2
Microphthalmos+strabismus+nystagmus	5
Microphthalmos+strabismus	1
Microphthalmos+nystagmus	1
Strabismus+nystagmus	1
Strabismus+coloboma of iris	1
Strabismus+nystagmus+aniridia	2
Coloboma of iris+coloboma of choroid	1
Total	32

Table 2 shows the relationship of the final vision to the presence or absence of associated ocular defects. Of 47 cases with no associated ocular defects in which the final vision was known, 70.2 percent obtained a final vision of 20/70 or better, while only 12.8 percent had a final vision of less than 20/200. On the other hand, in 13 cases with associated ocular defects in which the final vision was known, 30.8 percent obtained a final vision of 20/70 or better, while 38.4 percent obtained a final vision of 20/200 or less.

AGE AT OPERATION

One of the most controversial points in the treatment of congenital cataracts is the

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TABLE 2

RELATIONSHIP OF ASSOCIATED OCULAR DEFECTS TO FINAL VISION

Associated Ocular Defects	Number with Known Vision	Final Vision		
		20/70+	20/100–20/200	Less than 20/200
None	47	33 (70.2%)	8 (17.0%)	6 (12.8%)
Present	13	4 (30.8%)	4 (30.8%)	5 (38.4%)

choice of age for operation. Some have felt the cataract should be removed as early as possible in order to prevent the development of amblyopia ex anopsia and strabismus. On the other hand, a delay in the time of operation has been advocated by those who believe that a more mature eye can better withstand the operation.

In studying this problem, the eyes with associated ocular defects have to be considered separately from those without associated ocular defects. Table 3 shows the results of such a study. First, of the cases with no associated ocular defects, in 5 the operation was performed when the patient's age was less than 4 years. Of these only 40 percent obtained final vision of 20/70 or better and 60 percent obtained final vision of 20/200 or less. In 42 cases when the operation was performed on patients of 4 or more years of age, 73.8 percent obtained a final vision of 20/70 or better, while in only 7.1 percent was the final vision 20/200 or less. Therefore, the visual results were better in the cases in which the operation was performed when the patient was 4 years of age or over.

Although the number of cases with associated ocular defects was less, the same general trend was observed. In 4 cases in which the operation had been performed while the patient was less than 4 years of age, none obtained a final vision of 20/70 or better and 75 percent obtained a final vision of 20/200 or less. In 9 cases with associated ocular defects in which the patient was operated on at 4 years of age or over, 44 percent obtained a final vision of 20/70 or better, while only 22.2 percent obtained a final vision of 20/200 or less.

From these data it appears that better final visual results are correlated with operations performed at the later ages in life. One possible explanation of this finding is that the more mature eyes withstand the operative trauma better. Another more likely explana-

TABLE 3

RELATIONSHIP OF AGE AT OPERATION TO FINAL VISION

Associated Ocular Defects	Age of Operation (Years)	Number with Known Vision	Final Vision		
			20/70+	20/100–20/200	Less than 20/200
None	Less than 4	5	2 (40.0%)	0	3 (60.0%)
	4 or more	42	31 (73.8%)	8 (19.0%)	3 (7.1%)
Present	Less than 4	4	0	1 (25.0%)	3 (75.0%)
	4 or more	9	4 (44.4%)	3 (33.3%)	2 (22.2%)

tion may be that the eyes requiring operation very early in life have some other unknown congenital defects.

Type of operation

In most of the cases one of three methods has been utilized: (1) Single or repeated needlings without subsequent lavage; (2) needling followed by lavage of the anterior chamber several days later to remove cortical material; (3) linear extraction in which the eye is opened with a keratome; the anterior capsule of the lens is removed; the lens substance is minced with capsule forceps and removed by lavage. Recently in a few cases the lens has been removed by the intracapsular technique.

Table 4 shows the final visual results in our cases when they are divided according to the method of operation. The final visual acuity was known in 5 cases in which the cataract was removed by single or repeated needlings. Of these one obtained a final vision of 20/70 or better and one of 20/200 or less. The visual acuity was known in 17 cases in which the lens was removed by a needling and subsequent lavage. In 13 of these the final visual acuity was 20/70 or better and in one case the final vision was 20/200 or less. The method of linear extraction was used in 11 cases in which the final vision was known. All of these had a final visual acuity of 20/70 or better.

An intracapsular extraction was successful in 4 cases. In 3 of these the final vision was 20/70 or better and in one the vision was between 20/100 and 20/200. In 3 cases intracapsular extraction was attempted, but the capsule ruptured. Two of these cases obtained good vision (20/70 or better), while one obtained poor vision (20/200 or less). The lens was extracted by the extracapsular method in only two cases in which the final visual acuity was known, one of which had a final vision of 20/70 or better and one a final vision of between 20/100 and 20/200.

From these figures it appears that the results following single or repeated needlings are significantly poorer than the results following either a needling with subsequent lavage or the method of linear extraction. In this small series the final visual result following the method of linear extraction also appears statistically better than the results after needling followed by subsequent lavage.

Summary

The results in our cases show that the most important factor in determining the final visual outcome is the presence or absence of associated ocular defects. It also appears that better visual results can be expected when the operation is performed after 4 years of age. At the Wilmer Institute from October, 1943, to November, 1947, very few congenital cataracts were operated upon by the method of single or repeated needlings. In these cases the final visual outcome was poorer than when the method of needling with subsequent lavage or when the method of linear extraction was used.

Complications

Table 5-A shows the relationship of postoperative complications to the presence or absence of associated ocular defects. The incidence of postoperative complications was essentially the same in each group. Table 5-B shows the incidence of postoperative complications when the cases were divided according to the age of the patient at the time operation was performed. Here again there was no significant difference in the incidence of postoperative complications.

Table 6 (see page 416) shows that there was no statistically significant difference in the incidence of postoperative complications when the cases are divided according to type of operation performed.

A round regular pupil was obtained in 70.0 percent of the cases in which a linear extraction was done, and in 42.8 percent of the cases in which a needling was followed by subsequent lavage. In 92.3 percent of the cases in which single or repeated needlings were used to remove cataract, the pupil remained round and regular.

TABLE 4

RELATIONSHIP OF TYPE OF OPERATION TO FINAL VISION IN EYES WITH NO ASSOCIATED OCULAR DEFECTS OPERATED ON WHEN PATIENT WAS FOUR YEARS OF AGE OR MORE

Type of Operation	Number with Known Vision	Final Vision		
		20/70+	20/100–20/200	Less than 20/200
Single or Repeated Needlings	5	1 (20.0%)	3 (60.0%)	1 (20.0%)
Needling with Subsequent Lavage	17	13 (76.5%)	3 (17.6%)	1 (5.9)
Linear Extraction	11	11 (100.0%)	0	0

TABLE 5-A

COMPLICATIONS

Associated Ocular Defects	Number of Cases	Vitreous Loss	Anterior Chamber Hemorrhage	Iridocyclitis	Capsular Remains	Retinal Detachment	Cortical Remains	Lens Sensitivity	Glaucoma	Vitreous Opacities
None	55	13 (23.6%)	2 (3.6%)	1 (1.8%)	1 (1.8%)	1 (1.8%)	3 (5.5%)	1 (1.8%)	0	0
Present	32	4 (12.5%)	0	0	2 (6.3%)	0	1 (3.1%)	1 (3.1%)	2 (6.3%)	1 (3.1%)

TABLE 5-B

COMPLICATIONS

Age at Operation (years)	Number of Cases	Vitreous Loss	Anterior Chamber Hemorrhage	Iridocyclitis	Capsular Remains	Retinal Detachment	Cortical Remains	Lens Sensitivity	Glaucoma	Vitreous Opacities
Less than 4	33	6 (18.2%)	1 (3.0%)	0	3 (9.1%)	1 (3.0%)	1 (3.0%)	1 (3.0%)	2 (6.1%)	0
4 or more	54	11 (20.4%)	1 (1.9%)	1 (1.9%)	0	0	3 (5.6%)	1 (1.9%)	0	1 (1.9%)

TABLE 7-A

RELATIONSHIP BETWEEN NUMBER OF OPERATIONS AND ASSOCIATED OCULAR DEFECTS

Associated Ocular Defects	Number of Cases	Number of Operations			
		One	Two	Three	Four
None	55	23 (41.8%)	22 (40.0%)	9 (16.4%)	1 (1.8%)
Present	32	18 (56.2%)	8 (25.0%)	3 (9.4%)	3 (9.4%)

TABLE 7-B

RELATIONSHIP OF NUMBER OF OPERATIONS TO AGE OF PATIENT

Age at Operation (Years)	Number of Cases	Number of Operations			
		One	Two	Three	Four
Less than 4	33	13 (39.4%)	9 (27.3%)	8 (24.2%)	3 (9.1%)
4 or more	54	28 (51.8%)	21 (38.9%)	4 (7.4%)	1 (1.9%)

TABLE 8

RELATIONSHIP OF NUMBER OF OPERATIONS TO TYPE OF OPERATION

Type of Operation	Number of Cases	Number of Operations			
		One	Two	Three	Four
Single or Repeated Needlings	13	9 (69.2%)	2 (15.4%)	2 (15.4%)	0
Needling with Subsequent Lavage	28	0	19 (67.9%)	6 (21.4%)	3 (10.7%)
Linear Extraction	20	10 (50.0%)	7 (35.0%)	2 (10.0%)	1 (5.0%)
Intracapsular	11	11 (100.0%)	0	0	0
Broken Capsule	7	5 (71.4%)	1 (14.3%)	1 (14.3%)	0
Extracapsular	8	6 (75.0%)	1 (12.5%)	1 (12.5%)	0

TOTAL NUMBER OF OPERATIONS

Table 7-A shows that there was no significant relationship between the number of operations performed and the presence of associated ocular defects. Table 7-B is a similar study of the number of operations required when the cases are divided according to the age of the patient at the time of operation. It shows that the age of the patient at time of operation had no significant effect upon the number of operations required to remove the congenital cataract satisfactorily.

The number of operations required to remove the congenital cataract completely in the various methods of operation are shown in Table 8. This table presents an interest-

TABLE 6

RELATIONSHIP OF COMPLICATIONS TO TYPE OF OPERATION

Type of Operation	Number of Cases	Vitreous Loss	Anterior Chamber Hemorrhage	Irido-cyclitis	Capsular Remains	Retinal Detachment	Cortical Remains	Lens Sensitivity	Glaucoma	Vitreous Opacities
Single or Repeated Needlings	13	1 (7.7%)	0	0	1 (7.7%)	0	3 (23.1%)	1 (7.7%)	0	0
Needling with Subsequent Lavage	28	7 (25.0%)	2 (7.1%)	0	0	0	0	0	1 (3.6%)	0
Linear Extraction	20	2 (10.0%)	0	0	1 (5.0%)	0	0	1 (5.0%)	1 (5.0%)	0
Intracapsular	11	2 (18.2%)	0	0	0	0	0	0	0	1 (9.1%)
Broken Capsule	7	3 (42.8%)	0	1 (14.3%)	0	0	1 (14.3%)	0	0	0
Extracapsular	8	2 (25.0%)	0	0	1 (12.5%)	1 (12.5%)	0	0	0	0

TABLE 9-A

RELATIONSHIP BETWEEN NUMBER OF HOSPITAL DAYS AND PRESENCE OF ASSOCIATED OCULAR DEFECTS

Associated Ocular Defects	Number of Cases	Days in Hospital								
		Six or less	Seven	Eight	Nine	Ten	Eleven	Twelve	Thirteen	Fourteen or more
None	55	2 (3.6%)	0	3 (5.5%)	4 (7.3%)	2 (3.6%)	5 (9.1%)	10 (18.2%)	6 (10.9%)	23 (41.8%)
Present	32	3 (9.4%)	1 (3.1%)	1 (3.1%)	0	2 (6.3%)	3 (9.4%)	4 (12.5%)	4 (12.5%)	14 (43.7%)

TABLE 9-B

RELATIONSHIP BETWEEN AGE AT OPERATION AND NUMBER OF HOSPITAL DAYS

Age at Operation (years)	Number of Cases	Days in Hospital								
		Six or less	Seven	Eight	Nine	Ten	Eleven	Twelve	Thirteen	Fourteen or more
Less than 4	33	2 (6.1%)	1 (3.0%)	1 (3.0%)	1 (3.0%)	2 (6.1%)	2 (6.1%)	2 (6.1%)	3 (9.1%)	19 (57.5%)
4 or more	54	3 (5.6%)	0	3 (5.6%)	3 (5.6%)	2 (3.7%)	6 (11.1%)	12 (22.2%)	7 (12.9%)	18 (33.3%)

TABLE 10

RELATIONSHIP OF NUMBER OF HOSPITAL DAYS FOR PATIENT TO TYPE OF OPERATION

Type of Operation	Number of Cases	Hospital Days per Patient								
		Six or less	Seven	Eight	Nine	Ten	Eleven	Twelve	Thirteen	Fourteen or more
Single or Repeated Needlings	13	4 (30.8%)	1 (7.7%)	0	1 (7.7%)	1 (7.7%)	0	1 (7.7%)	1 (7.7%)	4 (30.8%)
Needling with Subsequent Lavage	28	1 (3.6%)	0	1 (3.6%)	1 (3.6%)	0	2 (7.1%)	3 (10.7%)	2 (7.1%)	18 (64.3%)
Linear Extraction	20	0	0	1 (5.0%)	2 (10.0%)	2 (10.0%)	1 (5.0%)	3 (15.0%)	4 (20.0%)	7 (35.0%)
Intracapsular	11	0	0	0	0	0	2 (18.2%)	5 (45.4%)	1 (9.1%)	3 (27.3%)
Broken Capsule	7	0	0	0	0	0	3 (42.8%)	2 (28.6%)	0	2 (28.6%)
Extracapsular	8	0	0	2 (25.0%)	0	1 (12.5%)	0	0	2 (25.0%)	2 (37.5%)

ing contrast between the cases operated on by the method of linear extraction and those operated upon by the method of needling followed by a subsequent lavage.

Naturally in all the cases in which needling was followed by subsequent lavage, 2 or more operations were performed. However, in 50.0 percent of the cases in which a linear extraction was used only one operation was necessary.

The use of the linear extraction, therefore, reduces the total number of operative procedures necessary and thereby greatly decreases the anesthetic and operative risks. Table 8 shows that only one operation was required in 69.2 percent of the cases in which the method of single or repeated needlings was employed. However, when this method of operation was used, the final visual result was poorer than the results obtained after linear extraction or needling followed by subsequent lavage.

Number of days in hospital

Table 9-A shows there was no significant relationship between the number of hospital days per patient and the presence or absence of associated ocular defects. Table 9-B shows a similar lack of correlation between the age of the patient at time of operation and the total number of hospital days per patient.

However, Table 10 shows that the method of operation had an important relationship to the total number of hospital days per patient—64.3 percent operated upon by needling followed by subsequent lavage spent 14 or more days in the hospital, while only 35 percent operated upon by the method of linear extraction spent 14 or more days in the hospital. The method of linear extraction is therefore superior in this respect because it has significantly decreased the number of hospital days per patient.

Comment

A comparison of our results with those reported by Owens and Hughes is interesting. In our cases the operations have been performed since October, 1943, while those reported by Owens and Hughes were performed before October, 1943. In the earlier series associated ocular defects occurred in 55.8 percent, but in our series similar associated ocular defects were present in only 36.8 percent, indicating that in the more recent years, operations have not been performed on many eyes having gross defects that would have been subjected to operation in the past.

In the early series, Owens and Hughes found better visual results when the operation was performed on patients over 2½ years of age. In the more recent series, the number of patients operated on at an early age is smaller. To obtain a large enough group to make a similar comparison, it was necessary to separate those cases operated upon when the patient was under 4 years of age from those operated upon when the patient was over 4 years of age. The comparison of the visual results of these groups confirmed the results of the early study by showing that the operative results were superior when the operation could be delayed.

The analysis of the operations performed since October, 1943, confirms the earlier experience that the method of single or repeated needlings does not give as good final visual results as linear extraction or needling followed by subsequent linear extraction.

From our data the most striking point in favor of the linear extraction is the reduction in the total number of operations necessary to remove the cataract completely. Owens and Hughes found similar results in their analysis. They reported that the percentage of cases requiring subsequent operations was essentially the same in the group having the single operation of linear extraction as in the group having the double operative procedure of discission followed by linear extraction.

In our series 50.0 percent of the cases having the single, primary operation of linear

extraction required only one operation to remove the cataract completely. The use of the simple linear extraction not only cuts down the total number of hospital days per patient, but greatly reduces the anesthetic and operative risks of removing congenital cataracts.

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APHAKIA*

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The purpose of this paper is to consider briefly and to stress again some of the salient features concerning the optical management of aphakia.

Changes in aphakic eye

The removal of the crystalline lens system changes the eye into an entirely different optical instrument. Using the constants of the normal, simplified schematic eye of Gullstrand, the power is reduced from 59.74 diopters to 43.08 diopters, a difference of about 16.6 diopters for air. This produces a principal point refraction of about 12.6 diopters of curvature hypermetropia.

The two principal points of the normal eye which were 1.505 mm. and 1.631 mm. behind the cornea now coincide at the vertex of the optical zone of the cornea. The nodal points which lay 7.13 mm. and 7.256 mm. behind the cornea in the lens containing eye are now replaced by a single point 7.8 mm. behind the cornea.

The direction of the visual axis, therefore, is changed and the eye must turn in a different direction to obtain an image at the fovea. The anterior principal focal distance is 23.214 mm. instead of 16.74 mm. in the normal eye. The size of the retinal image by the aphakic eye to that of the lens-containing eye is in the proportion of 23.21 :16.74, about 1.38×. It would be formed 31.014 mm. behind the cornea, that is 7.014 mm. behind the retina of the aphakic eye; a refractive change of about 4 diopters for each 3 mm. of elongation instead of about 3 diopters for each 1-mm. difference in the normal eye, but the proportion of 4:3 does not hold precisely unless the correcting lens is placed at the anterior principal focus of the eye.

Refraction of aphakic eye

The lens that would correct this error and bring forward the image of a distant object so that it would be formed on the retina, must be of such dioptric power and denomination that the distant object would be placed (optically) at the far point of the eye which lies about 79.43 mm. behind the cornea. If this lens were situated at the anterior principal focus of the eye, it would have a power of about +9.75 diopters and the retinal image would be 38 percent larger

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* Read before the New England Ophthalmological Society, January 21, 1948.

than the image in the normal eye. Of course, the spectacle lens is always set closer than 23 mm. from the cornea.

If it were placed at about 14 mm. in front of this schematic aphakic eye, it would have to have a power of about +10.7 diopters and, while the retinal image would not be so great because of the lessened distance, it would still be about one-third larger than that in the normal, lens-containing eye.

The size of the retinal image in aphakia depends on the refraction of the eye before removal of the lens. The image in the previously myopic eye will be larger than in the previously emmetropic eye because a convex lens of less power will be required to correct it. The image will be smaller in the eye that was hypermetropic before operation. But in every case of aphakia the retinal image is larger than before extraction of the crystalline lens and it is due to this enlargement that better than average normal visual acuity is frequently obtained in aphakia.

Eye devoid of accommodation

Besides these changes, the eye is now devoid of any accommodation whatever, and this loss is not unimportant because, even in aged persons, there is some power of accommodation, and be it ever so slight it helps in the adaptability of the eye. Properly corrected for distance and no accommodation, the vision becomes noticeably blurred from 4 meters in.

Also after removal of the crystalline lens, especially a senile lens, the eye becomes hundreds of times more sensitive to violet and ultraviolet light than before. Often there is some degree of erythropia after cataract operation, especially in those patients whose pupils have been enlarged by iridectomy. Cyanopia may occur immediately after extraction and last several weeks. These conditions are always transient.

In addition to the changes mentioned, regardless of the skill of the surgeon and the healthy success of an extraction of a senile cataract, there remains, in nearly every case, a more or less mutilated eye.

Unusual new vision

The wonder is why all of these elderly persons who have been operated on for cataract are not confused and, to a certain extent, disappointed in their entirely new kind of eye. It seems only reasonable that many find it hard to accustom themselves to it. The ophthalmologist, therefore, in treating a patient with aphakia after extraction of senile cataract, must always bear in mind that he is treating an elderly person who has just had his sight restored, but by the use of a strange, new optical instrument.

An unusual kind of vision is provided, possibly more acute than ever before, but with larger images, different aberrations, a changed pupil, and lessened focal depth. The patient must accustom himself to strong glasses with all their faults, a smaller field, and the probable image distortion with a newly acquired astigmatism.

Often it will be seen that the patient will find it difficult, at first, to fixate an object so that it will lie exactly on his new visual axis in order for it to be imaged at the fovea. While with most of these phenomena nothing can be done except to explain them away, some can be refined out or softened with carefully chosen and adjusted glasses. The optical management of aphakia is usually difficult for the younger man and often for the experienced ophthalmologist, too.

Optical management of aphakia

All the accessory effects of the correcting glass before any ametropic eye are exaggerated in the case of aphakia corrected by a convex lens of around 10 diopters. The focal distances and the location of the lens itself are measured from its principal planes, and the position of the principal planes depends on the shape and thickness of the lens. Even though the finished lens has the same equivalent power, unless it is

of the same shape and thickness as the trial lens, the vertex power, and therefore the effectivity of the spectacle lens, will not be the same.

In low-power lenses, the difference in effectivity is so slight it may be disregarded, but in strong convex lenses it is important. For example, an 11-diopter, equal sided, biconvex lens 7-mm. thick has a vertex power of about 11.12 diopters. If this lens were replaced by a meniscus lens with—3-diopter back surface and +14-diopter front surface, and its back surface in the same plane, the effective power would be about 11.88 diopters—a difference of about 0.75 diopter. The same rate of change is also produced in the cylindric component.

Importance of visual axes

Uninformed opticians are under the impression that the pole of the spectacle lens (the so-called optical center) should coincide with the center of the pupil. With ordinary low-power lenses and normal eyes this may be done without notable error. But we know that, properly, the pole of the lens should coincide with the visual axis, which does not usually pass exactly through the center of the pupil.

In the case of displaced, mutilated, irregular, or multiple pupils the visual line may not go through the pupil at all. It may even pass through an opacity. In the case of a 10-diopter lens, in which a decentration of 1 mm. produces a prism of 1 diopter, proper centering in binocular aphakia is very important.

If the lenses are alike or nearly so, the conjugate movements of the eyes can bring them into such parts of the lenses that the apparent displacement and distortions are in the same direction for the two eyes; but if they are improperly adjusted with regard to the visual axes or if there is a material difference in the strength between the two lenses or if they contain strong cylinders with marked angular difference between their axes, the prismatic effect is unequal as soon as the eyes turn from looking through the poles of the lenses. This prismatic effect, particularly in vertical and oblique directions, may be enough to cause the patient a great deal of discomfort.

Tilting of lenses

The tilting of these lenses is also important. Roughly about a 0.12-diopter cylinder is produced for every diopter of the given lens power with a tilting of 20 degrees, so that in looking at this obliquity through a 10-diopter lens there will be produced the equivalent of a 1.25-diopter cylinder with axis perpendicular to the direction of the movement of the eye. With a fixed spectacle glass, looking obliquely starts the moment the eye turns from looking straight forward. It is easy to conceive how, in looking obliquely through these lenses, a cylindric component at one time can be increased by a whole diopter while on looking along the opposite direction the same amount can be neutralized out.

Amount of refractive error

In the correction of any form of ametropia it is important first of all to determine the most nearly approximate refraction; but it is of equal importance that the finished spectacle lens produce as closely as possible the same effective power as that of the trial lenses. The refractionist therefore should give careful consideration to such controllable factors as the flexure of the lenses, the style of bifocal, and the best adjustment and position of the spectacles before the eyes. The importance increases, of course, with the amount of the refractive error.

In order to procure an effective power in the finished spectacle lenses which approximates that of the trial lens combination, the ophthalmologist whose equipment consists of old-fashioned double convex and double concave spheric trial lenses must either prescribe lenses that nearly duplicate the shape

of his trial lenses or the spectacle lenses must be carefully computed and ground with such back-front curves that they will have the same effectivity.

If the lens contains a cylinder, the closest duplicate of the double convex cylindric trial lens combination will have one side spheric and the other toric. For example, a +10D. sph. ⌒ +2.0D. cyl. ax. 180° should have one side a +5.0D. sph. and the other side a +5.0D. sph. ⌒ +2.0D. cyl. ax. 180°. But a double convex lens is not a good form even in a low power.

A good form lens of about 10 diopters is one which might be started from either about +14 diopters in front or about −3 diopters in back. Variations of 2 or 3 diopters in back-front combination will not make a great difference providing the back surface is concave.

At best the field is bound to be restricted through such a strong convex lens and all the faults besides the prismatic effects toward the periphery must be accepted. It is practically and theoretically impossible to eliminate the astigmatism of oblique pencils and other serious faults of a convex spectacle glass of around 10 diopters, especially if it contains a cylindric component.

Approximation of effectivity

An approximation of the effectivity can be obtained by arranging the lenses in the trial frame to resemble the shape of the finished lenses. Compared with the thickness and index of refraction of a biconvex lens of +10 diopters having an effective power of 10.08 diopters, two equal-sided lenses, +13 in front and −3 in back, will have an effective power of around +10.5; a +10-diopter meniscus with −3 back will have an effective power of +10.55 diopters.

Plano-trial lenses (every trial lens should have a plane surface) can be arranged so that they will conform to the finished spectacle lenses with negligible difference. Take a case, for example, in which by the ordinary procedure of manifest refraction the final combination is +11 diopters.

Simply replace the single +11-diopter lens with two lenses, one −3 diopter with concave surface toward the eye as close to it as possible or at the exact distance the spectacle lens will be placed, and in front, in apposition to the plane surface of the concave lens, place the plane surface of a +14-diopter convex lens.

After testing subjectively for small differences with quarter- and half-diopter additions and subtractions, suppose the final result totals +10.5 diopters; order the lens ground with +13.5 diopters in front and −3 diopters in back.

The advantage of a meniscus over a flat lens is that, optically, it lies farther away from the eye than its actual position. This is good in hypermetropia because, for distance vision, the farther away from the eye the correcting lens the weaker its power must be and the larger the retinal image.

Suppose, for example, the result by the usual method is a sphero cylinder, +11D. sph. ⌒ +2.0D. cyl. ax. 180°. Ordinarily this combination will consist of a +11-diopter spheric lens in the rear cell and a +2-diopter cylinder in the front cell of the trial frame. Replace these lenses with a −2-diopter cyl. ax. 90°, concave surface toward the eye and as close as the spectacle lens will be and, in front of this with curved surface in front and plane surface behind and in apposition to the front, plane surface of the cylinder, a +13-diopter sphere.

In this way we have transposed the combination from +11D. sph. ⌒ +2.0D. cyl. ax. 180° to +13D. sph. ⌒ −2.0D. cyl. ax. 90°, its numerical equivalent.

This combination will, of course, not have the same back power and it will be necessary to add quarter or half diopters to both sphere and cylinder to find the difference. The axis, having been carefully determined in the first stage, will remain. If after the refinement by subjective tests

the final result is +12.5D. sph. ⊃ −2.0D. cyl. ax. 90°, order the lens to be ground as written. It is a good form.

By this procedure no computation is necessary nor need any allowances for shape or distance be made, provided the spectacle lenses are placed at the same distance from the eyes as were the trial lenses.

A change in distance of only 1 mm. away from the eye is likely to make a noticeable difference in effectivity in such strong lenses and this should be determined by pushing the lenses closer or pulling them away slightly when the patient returns to have them checked. If, by doing this, any improvement can be made one way or the other, have them readjusted.

Prescribing bifocals

These better forms can be obtained in fused bifocals in which the segments will be placed in the front spheric surface. If one-piece bifocals are preferred they can be ground with segment on the −3-diopter back surface in the case of spheric lenses. The spherocylindric lenses can also be made in one-piece bifocals but they must be specially ordered because the segment must be incorporated in the front spheric surface.

The advantages of cement bifocals should not be overlooked. Cement bifocals are optically good and will often be found useful and economical, especially for the first glasses when it is likely that the correction may have to be changed in a short while.

The segment of any of these bifocals should be so cut that the base is down, to neutralize somewhat, but more particularly not to exaggerate, the strong prism, base up, already in the lower part of the distance glass. For this reason flat-top segments are fundamentally wrong in any bifocal with convex distance lens.

Also, too often it is forgotten that the ordinary reading distance is nearer 14 inches (2.75D.) than 13 inches (3.0D.). If the media are clear and the visual acuity good, there is no reason ordinarily for stronger reading additions than 2.75 diopters. This will give a greater range and usually prove more satisfactory than additions of +3 or +3.25 diopters, which are so frequently prescribed in aphakic corrections. Stronger additions for near are justifiable, however, when the visual acuity is low, especially with monocular vision.

Monocular aphakia

The correction of monocular aphakia (one eye normal with good visual acuity) is impractical, not only because of the diplopia due to the aniseikonia and to the prismatic effect of the difference between the glasses, but also because the patient has two different optical instruments, one dynamic with more or less active accommodation and normal adaptability and the other static.

It has been claimed that binocular single vision from infinity in to 10 inches has been obtained by the use of a contact glass for persons with monocular aphakia, even for young persons with accommodation in the normal eye sufficient for all ordinary distances.

If the retinal images are made equal in size it is possible to superimpose one on the other, but perfectly for only one distance at a time. But even then, mere equalization of the retinal images is not sufficient to produce single binocular vision. It is hard to conceive how this is physiologically possible with such a pair of eyes. But it is equally hard to explain accommodation for near vision in aphakia as has sometimes been reported.

The same reasoning regarding a contact glass can be applied to the usefulness of minifying glasses with the added disadvantages of their unsightliness and small field. While these devices may enable a patient to obtain a sort of binocular vision, it cannot possibly be good and might cause considerable discomfort, nevertheless if a patient seems to be comfortable with such a

quality of vision there is no reason why it should not be given.

In monocular aphakia, immature cataract in the other, the eye chosen for correction will, of course, be the one with the better visual acuity. In many instances, however, the patient will prefer the use of the lens-containing eye even though the visual acuity cannot be brought up to that of the aphakic eye.

In monocular aphakia (only the aphakic eye functioning) the proper power and shape of glass and its position before the eye are important, but this is a simple matter compared with the correction of a pair of aphakic eyes.

Correction of binocular aphakia

It is in the correction of binocular aphakia that the greatest care must be taken to observe the characteristics of the eyes and to utilize the power, shape, and adjustment of the lenses to the best advantage of the patient. It is sometimes very difficult for an elderly person to coördinate two aphakic eyes, providing they do coördinate.

For this reason, probably in many instances the patient who submits to the removal of the cataract in the second eye is often disappointed after the second operation. This is especially true if there is a material difference between the refractions of the two eyes.

To the mind of the layman it is logical to suppose that two eyes are better than one, so much better that he is willing to risk a second operation even though a good result was obtained by the first. But it seems that most ophthalmologists also think the same way.

Often after combined operation, the amount of light which enters the eye through the enlarged pupil is so much greater than that to which the patient is accustomed that it causes considerable glare. This excessive light, particularly the selective nature of it, is likely to prove very annoying for some time following the operation, and protection is often desirable. For this purpose dark glasses may be given for those times when the occasion warrants. They should never be ordered for permanent, constant use. For obvious reasons light shades are just about useless. When dark glasses are given they should be dark enough to serve their purpose.

The provision of the best optical correction for aphakia requires special skill, experience, and a knowledge of the scientific principles involved, but also it must be constantly borne in mind, as already stated, that we have also to treat a patient that frequently is a more or less perplexed, elderly person who, by means of a serious operation, has just recently been given an entirely new kind of vision.

1930 Chestnut Street (3).

NEWER CONCEPTS IN THE CLASSIFICATION OF THE GLAUCOMAS*

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With the introduction of gonioscopic and chamber-angle depth observations into recent considerations of ocular hypertension, it has become obvious that many of the older ideas about glaucoma need modification. These changes have been sufficient to require a broader concept of the etiology, course, and even of the treatment of the various ocular conditions which have in common an elevation of intraocular pressure.

The term *glaucoma* does not apply to a particular ocular disease entity but rather denotes only the presence of increased intraocular pressure. Thus, glaucoma may be one of the manifestations of a large group of ocular diseases which may be called *the glaucomas*. From the viewpoint of what constitutes an increase in intraocular pressure and, therefore, glaucoma, it must be considered as that pressure which the individual eye cannot tolerate without some damage to its integrity.

Let us consider the classification of the glaucomas as a framework for the various concepts to be discussed.

Von Graefe[1] distinguished four clinical varieties of glaucoma; namely, acute glaucoma, absolute glaucoma, secondary glaucoma, and "amaurosis with excavation of the disc" (chronic simple glaucoma).

The classification in general use today is more elaborate but actually differs little from von Graefe's. It may be divided into three groups:

I. Primary or idiopathic glaucoma
  A. Congestive glaucoma (inflammatory, incompensated)
    1. Acute
    2. Chronic
  B. Chronic simple glaucoma (noninflammatory, compensated)
II. Secondary glaucoma
III. Hydrophthalmos

Absolute glaucoma is the end stage of any of the glaucomas and need not be included in any classification.

The weaknesses of this classification lie in the lack of etiologic connotation and in its failure to provide a cubbyhole for all the clinical varieties of glaucoma.

One of the things which started my dissatisfaction with this classification was my inability to classify properly the type of glaucoma which occasionally follows instillation of mydriatic drugs in patients with shallow anterior chambers and without previous ocular hypertension. Here the patient shows no evidence of vascular congestion, but the tonometric reading may be well over 60 mm. Hg (Schiøtz). The condition is acute but not congestive; so it does not fit into either the acute congestive glaucoma or the chronic noncongestive glaucoma cubbyholes, although the latter is where many men have placed it.

A review[2] of a series of 45 patients with acute glaucoma was made to determine whether the presence or absence of congestion was a justifiable criterion in the classification of glaucoma. The results of the study indicated that 95.4 percent of the 24 cases precipitated by mydriasis (mydriatic drugs or darkness-dilatation) were free from congestion at the onset. Of the 7 with acute episodes precipitated by accommodative effort, 80 percent started without congestion. In the group of 18 cases precipitated by vascular engorgement, presumably involving the vessels of the ciliary body, 53.3 percent were congested from the onset.

It appeared, then, that in a majority of cases of acute glaucoma, the onset was not

* From the Wayne University College of Medicine and Receiving Hospital, Detroit. Under a grant from the W. K. Kellogg Foundation.

associated with congestion, but, after a varying period of time, the eye suddenly became congested, due, probably, to the presence of histaminelike metabolic products resulting from the poor nutrition and hypoxia associated with the interference with the blood supply by the high intraocular pressure.

Congestion is only a phase into which an eye with acute glaucoma may or may not enter, depending on the precipitating factors and the duration and height of the increased intraocular pressure. Therefore, the descriptive terms congestive and noncongestive and their synonyms were eliminated from the diagnosis and only appended after it as follows:

Acute glaucoma, noncongestive phase
Acute glaucoma, congestive phase
Simple glaucoma, noncongestive phase
Simple glaucoma, congestive phase

Another weakness in the generally used classification is its tendency to give the impression that the various primary glaucomas are various stages of the same disease so that one clinical picture may change to another and then even revert back to the original type. Beginning with Raeder,[3] in 1923, there has come a separation of the two primary glaucomas of adult life into two separate entities, based on the depth of the chamber angle. This has been amply confirmed by gonioscopic evidence and by provocative mydriasis.[2]

One confusing consideration is how to classify acute glaucoma which remains unrelieved by treatment. This is still acute glaucoma which has entered a chronic phase. The term acute glaucoma is used to designate a specific entity and should be used as the diagnostic term, even though the words "chronic phase" may be appended.

The classification which I wish to present is based on an attempt to continue the time-honored terms *primary* and *secondary* glaucoma and yet maintain an etiologic viewpoint.

My first attempts at classification of the glaucomas considered only chronic simple glaucoma as primary since this was considered the only condition whose relation to any other ocular disease was not known. Since acute glaucoma results from a known anatomic cause, it was classified as secondary.

Following this classification it was only a step further to avoid the terms primary and secondary entirely and simply to classify each type of glaucoma according to its causal relationships. But because we do not yet know the cause of the most important glaucoma—chronic simple glaucoma—and because of usage, I have reverted in teaching to the use of the terms primary and secondary.

The primary glaucomas, according to my present concept, are those which do not follow other ocular disease. In this group are included the idiopathic chronic simple glaucoma cases and those cases caused by anatomic and developmental anomalies. The latter are subdivided into the congenital glaucomas and acute (narrow-angle) glaucoma which depends on both an anatomic predisposition[4]—a narrow angle usually associated with high hyperopia—and the normal continuous growth of the lens with increasing age, together with such physiologic angle-narrowing factors as accommodation, dilatation of the pupil, and congestion of the ciliary body.

The classification of the glaucomas in Table 1 is suggested on the basis of the definition of primary glaucomas just presented.

A consideration of the diagnostic clinical features of each of the glaucomas would be beyond the space available in this paper. However, a consideration of the important ones, especially those which present a diagnostic problem and those about which newer concepts have arisen, will serve to describe the desired material.

Glaucoma simplex

By far the most important of the glaucomas is the classical glaucoma simplex. The usual patient with early glaucoma simplex has no symptoms until changes in the visual fields bring the condition to his attention. Occasionally some fogginess of vision and

TABLE 1

A CLASSIFICATION OF THE GLAUCOMAS

I. PRIMARY GLAUCOMAS

A. Chronic simple (normal angle width) glaucoma { noncongestive phase; congestive phase (rare) }

B. Glaucomas caused by anatomic and developmental anomalies
   1. Congenital glaucomas
      (a) Hydrophthalmia
      (b) Glaucomas associated with aniridia or with neurofibromatosis
   2. Juvenile glaucoma. (Only those cases related to developmental anomalies belong here.)
   3. Acute (narrow-angle) glaucoma—due to anatomic plus physiologic angle-narrowing factors which lead to mechanical obstruction of trabecular spaces by iris. This includes the acute glaucoma associated with microcornea
      (a) Noncongestive phase—including "dilatation glaucoma"
      (b) Congestive phase—classical "acute congestive glaucoma" and the recurrent form called "chronic congestive glaucoma" in the older classification

II. SECONDARY GLAUCOMAS (Each may be subdivided into a noncongestive and a congestive phase; some never enter the congestive phase.)

A. Secondary glaucoma due to mechanical blockage of the trabecular spaces
   1. Obstruction by iris
      (a) Acute secondary glaucoma due to lenticular intumescence
      (b) Acute secondary glaucoma due to dislocation of the lens into the anterior chamber
      (c) Glaucoma following operation for cataract—*aphakic obstructive* glaucoma—due to delayed reformation of the anterior chamber
      (d) Glaucoma associated with essential progressive atrophy of the iris
      (e) Glaucoma associated with retrolental fibroplasia
   2. Obstruction of the trabecular spaces by particulate matter
      (a) Glaucoma capsulare
      (b) Pigmentary glaucoma
      (c) Glaucoma due to obstruction by lens particles
      (d) Glaucoma due to tumor growth
      (e) Glaucoma due to cellular debris associated with active or healed iridocyclitis

B. Secondary glaucomas due to lack of communication between the anterior and posterior chambers
   1. Secondary glaucoma due to seclusion of the pupil
   2. Secondary glaucoma due to total posterior synechia

C. Secondary glaucomas probably due to overproduction of aqueous as a result of irritation of the ciliary processes
   1. Glaucoma associated with posterior dislocation of the lens so that latter touches ciliary processes
   2. Cyclitis and anterior choroiditis

D. Secondary glaucomas due to obstruction of venous drainage
   1. Experimental and clinical glaucoma due to vortex-vein obstruction
   2. Secondary glaucoma in pulsating exophthalmos

E. Secondary glaucomas due to newly proliferated anastomotic vessels involving the Schlemm's canal mechanism in rubeosis iridis (diabetic and arteriosclerotic) and following occlusion of the central retinal vein

F. Secondary glaucoma resulting from trauma

G. Secondary glaucoma associated with epidemic dropsy

H. Secondary glaucoma associated with choroidal angiomatosis

diminished accommodation bring him to the oculist. Less frequently, colored halos around lights and headache are complained of. In the later stages the patient complains of night blindness, contraction of the visual fields, or even interference with macular vision.

Objectively, the ocular findings in simple glaucoma depend on the stage of the disease. The earliest findings are a slight ocular hypertension and changes in the pericecal visual field, usually manifested as a vertical increase in the size of the blindspot. As the disease progresses, the field changes increase slowly so that various characteristic changes, such as Bjerrum's sign and Roenne's step, occur. Excavation of the optic disc begins at the temporal side of the disc. As the disease progresses, the excavation of the disc increases concurrently with contraction of the field, until only a central zone about 10 degrees in diameter remains.

If allowed to continue untreated, the tension usually remains between 30 and 45 mm. Hg (Schiøtz); and the central field is finally lost. In this state of absolute glaucoma, the

eye may remain painless and pale or may, rarely, after a considerable time, suddenly enter a congestive state, in which the conjunctival vessels become injected, the eye painful, and the tension high. In fact, the suddenness of the onset and the symptoms may be the same as in an eye with acute glaucoma which has entered the congestive phase.

The few eyes with early simple glaucoma which have been studied in the laboratory show no abnormalities. The late stages of unoperated simple glaucoma show only the effects of increased intraocular pressure.

The diagnosis of early simple glaucoma depends on routine tonometric studies. Tactile tension estimations are so notoriously inaccurate that they cannot be termed a useful subsitute for the instrumental measurements.

The experience of the residents in ophthalmology at the Detroit Receiving Hospital serves to emphasize the value of routine tonometry. In March, 1947, when the present glaucoma clinic at that institution was started, there were about 18 active glaucoma patients, all in an advanced stage. Routine tonometry on all eye-clinic patients of 40 years of age or over led to an increase of glaucoma patients during the first nine months to 118, a high proportion of which were in the earliest stages.

Gonioscopically, the chamber angle is normal in depth in simple glaucoma, although one occasionally finds cases of simple glaucoma in which the chamber and the angle are relatively shallow. The shallowness is coincidental, since the factors leading to relative shallowing of the chamber are present in persons of the age group affected. In the late stage of simple glaucoma in which sometimes a congestive phase appears, peripheral anterior synechias may form.

The slitlamp findings in simple glaucoma are entirely negative except in the later stages when congestive episodes may have occurred. Then the evidences of congestive and atrophic changes are seen.

The provocative tests, including the water test and pressor-congestion test,[7] are of considerable help in the diagnosis of early cases of simple glaucoma, especially when the tonometric readings are 28 to 30 mm. Hg (Schiøtz) or when the tonometric readings are lower but the history or clinical findings are suspicious. The provocative tests are significant only when positive.

In the more advanced stages, the diagnosis is made on the basis of the visual fields, the tension, and the appearance of the nerve-head.

Primary acute glaucoma

The second of the glaucomas in importance is primary acute (narrow-angle) glaucoma. It is not difficult to diagnose in the full-blown congestive phase but the differentiation, in the noncongestive phase, from simple glaucoma and, in the congestive phase, from the secondary glaucomas, is usually difficult, and of much more than academic importance.

The actual onset of the noncongestive phase of acute glaucoma is hardly noticed by the patient. Blurring of vision may be noticed, especially among the younger patients. Sometimes the onset is associated with colored halos, or slight pain in the head or in the eye. These mild symptoms usually last a half-hour to two or three hours and then subside entirely, only to recur at varying intervals, becoming more frequent and lasting longer as time goes on, each attack leaving the anatomic conditions more favorable for further attacks. The circumcorneal injection associated with these episodes is slight, if any.

Occasionally the patient finds relief from his symptoms by the use of hot or cold applications, by looking at a bright light for several minutes, or by sleep.

Ultimately, one of the mild episodes will persist longer than usual, and suddenly the patient will experience marked diminution in vision, photopsia, swelling and redness of the conjunctiva, and pain in the head and the eyes, often so severe as to cause nausea and vomiting.

The sudden change in symptoms often

awakens the patient from sleep and occurs without any precipitating factor, it being an aggravation of the previous mild symptoms. It is induced by a sudden congestion of the globe, probably as a result of the accumulation of tissue metabolites within the eye when the blood supply and drainage of the intraocular fluid is impeded due to the high intraocular pressure. At any rate, the sudden aggravation of symptoms is attributable to the combination of high intraocular pressure and increased permeability of the vascular walls.

In some cases, the first mild noncongestive episode of acute glaucoma is followed by the congestive phase. Of course, if treated early with miotics, even the congestive phase subsides rapidly, and if the patient does not use miotics as a prophylactic measure it will likely recur, the disease passing again through the noncongestive phase. What has been previously called the prodromal stage of acute glaucoma is in reality the noncongestive phase of the disease.

In many patients with episodes of primary acute glaucoma, there is a history of onset of the condition following nervous shock. Many authors for this reason attribute primary acute glaucoma to a nervous cause. Actually the neurovascular factors are important only as the precipitants of the angle-blocking mechanism.

Objectively, the tension may not be different in the noncongestive and in the congestive phase. It is usually very high in the latter, since the additional vascular congestion adds to the mechanical obstruction of the angle.

Shallowness of the anterior chamber is typical of this type of glaucoma and is its predisposing anatomic cause. For this reason the nonglaucomatous fellow eye of a patient who has had an episode of primary acute glaucoma may be classified as preacute glaucoma. The same term may be used to describe the interim of normality between episodes of primary acute glaucoma in either the noncongestive or the congestive phase.

Shallowness of the anterior chamber in this form of glaucoma is usually associated with high or relatively high hyperopia, especially during the patient's early adult life.

When vascular decompensation occurs, it produces not only chemosis of the conjunctiva but edema of all the ocular tissues. The corneal epithelium is so involved that details in the fundus are obscured. Blebs and vesicles appear on the cornea. The cornea loses its sensitivity. In the noncongestive stage, even in the presence of very high tension, the cornea is not edematous, and arterial pulsation is easily seen in the fundus.

The pupil is dilated in both phases of acute glaucoma but is irregular in the congestive phase. The dilatation, when it is not in itself the actual etiologic factor in the onset of the disease, is probably due to slight stretching of the eyeball and to the pressure effect on the nerves.

In rabbits, if a needle is inserted into the anterior chamber and the pressure increased, the pupil dilates, and it contracts when the pressure is decreased.

Barkan[8] suggested that the vertically oval shape of the pupil is due to anatomic narrowness of the angle above. Undoubtedly, in the congestive phase the blood supply to a few of the nerve fibers to the sphincter is affected irregularly, and irregularity of the pupil results.

The iris in the congestive phase becomes muddy and discolored. Some of the iris vessels become visibly distended. If the congestive phase persists any length of time, fine posterior synechias may form.

The nervehead in the noncongestive phase is normal. In the congestive phase, it is red but not excavated. If repeated attacks occur or if an attack persists, the disc becames rather rapidly excavated.

Biomicroscopy reveals abnormalities only in the congestive phase or after the eye has suffered the effects of long-standing pressure as in simple glaucoma. Edema of the epithelium, blebs, and vesicles are seen in the congestive phase. The contents of the anterior chamber and the vessels of the iris are difficult to see clearly in this phase. Chemi-

cal studies are of no etiologic significance but show only the results of the vascular changes.

In the noncongestive phase, gonioscopy reveals the contact between the iris and the trabecular wall. In the congestive phase, closure of the angle must be presumed, since the cornea is usually too cloudy for visibility.

In a person in whom a congestive attack is relieved spontaneously or with miotics, floating particles of pigment, irregularity of the pupil, occasional fine posterior synechias, and pigment on the posterior corneal surface are seen. Slight persistent pericorneal injection may be present. If a patient is seen for the first time after such an attack, the tension in the eye is usually below normal and an erroneous diagnosis of acute iritis may be made.

When the congestive phase of acute glaucoma has been allowed to exist without treatment, the eye eventually becomes blind and enters the stage common to all glaucomas, namely, absolute glaucoma. The eye remains injected, the episcleral veins remain dilated, vesicles form on the cornea, and the iris remains muddy. Pain persists. Gradually, the vascular system adjusts itself somewhat, and the eye often becomes less painful.

Secondary glaucomas

Of the secondary glaucomas, those due to obstruction of the trabecular spaces by iris deserve consideration as a group. They have the same mechanism as primary acute glaucoma. This is most obvious in the acute secondary glaucoma due to lenticular intumescence which not only has the same mechanism but has the same clinical picture except that only one eye is usually involved in the process; that any refractive error, even high myopia, may have been present; and that an intumescent cataract is present. An anterior chamber of normal depth in the fellow eye is an important differential sign. I have never seen a primary acute glaucoma with a normally deep anterior chamber in the fellow eye.

Secondary glaucoma following cataract operation has been proved clinically to be due to obstruction of the trabecular spaces by iris only since my preliminary report on the gonioscopic findings in 1940. It is important not only as proof for the fact that obstruction of the trabecular spaces can cause a rise in the intraocular pressure in human beings, but in the differential diagnosis from other glaucomas occurring coincidentally in an eye which has had surgery for cataract.

In this type of glaucoma, the obstruction of the trabecular spaces usually results from delayed reformation of the anterior chamber due usually to failure to obtain tight wound closure.

The clinical picture varies considerably, depending on whether it occurs early or late after the operation. When it occurs early, the eye is usually congested and painful, and may be mistaken for a postoperative inflammatory process. Late onset may be free of congestion and lead to symptom-free loss of vision as in glaucoma simplex.

The diagnosis depends on gonioscopy. The etiologic factor may be relieved surgically by the cyclodialysis operation in both the congestive and the noncongestive phases.

The secondary glaucomas due to obstruction of the trabecular spaces by particulate matter are of several types, depending on the obstructing material. The diagnosis in each depends on gonioscopic examination of the chamber angle. The type, designated as glaucoma capsulare,[9] is associated with the exfoliation of the zonular lamella of the lens capsule. It is impossible, in this group, to be certain whether the capsular debris or the pigment granules deposited in the trabecular spaces, or both, are the cause for this type of glaucoma.

A second type of secondary glaucoma associated with a marked deposition of pigment in the trabecular spaces, without capsular exfoliation, is a form of glaucoma which has recently been described as an entity. It has been designated as *pigmentary glaucoma.*[10]

It was observed in two young myopic individuals with degeneration of the pigment epithelium of the iris and ciliary body. The pigment was deposited as a dense trabecular pigment ring in the trabecular spaces and as Krukenberg spindles on the posterior corneal surface as well as on the anterior iris surface. It differs from chronic simple glaucoma clinically in its response to mydriasis by significant elevation of the intraocular pressure.

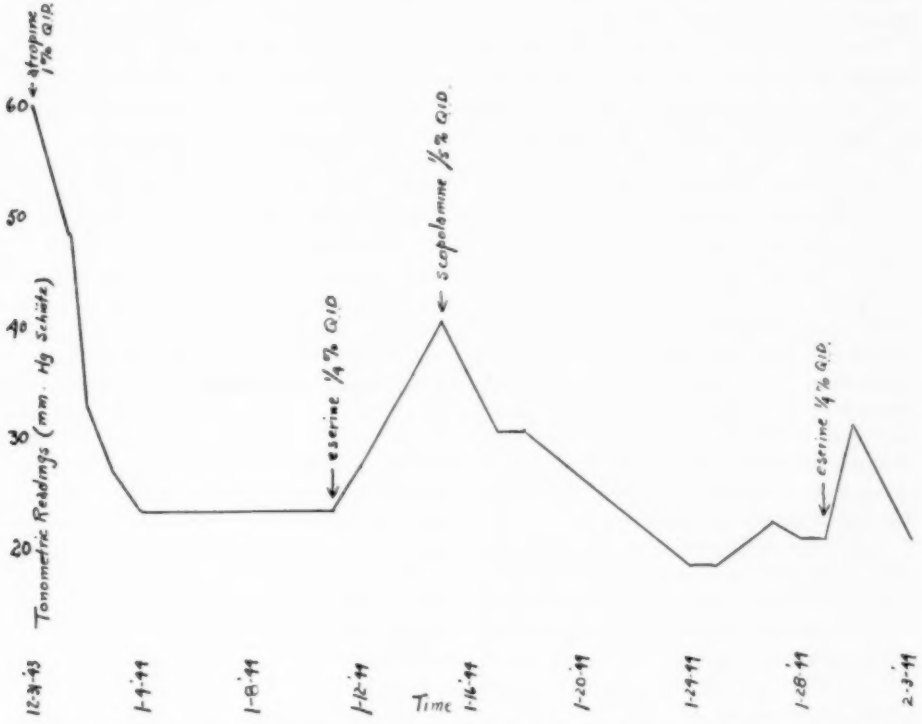

Fig. 1 (Sugar). Graphic representation of the effect of cycloplegics and miotics in the treatment of cyclitic secondary glaucoma.

Secondary glaucoma due to obstruction by cellular debris in the angle is difficult to differentiate from simple glaucoma when the antecedent iridocyclitis is completely inactive. Only the history of a previous iridocyclitis and the gonioscopic and biomicroscopic findings suggest the possible cause. If the condition is and remains unilateral, the diagnosis is more probably correct. In this case, the treatment is exactly the same as that for simple glaucoma, both medically and surgically.

The secondary glaucoma associated with cyclitis or anterior choroiditis is probably due to an overproduction of aqueous and is usually temporary, lasting only as long as the irritative inflammatory process persists in a relatively quiet form.

It is interesting that early in these inflammatory processes, when the eye is congested, the intraocular pressure is usually lower than normal, as in ordinary acute iritis. This is presumably due to a general vasodilation involving the iris and ciliary body.

As the inflammatory process appears to subside, and the eye becomes relatively paler or completely white, the intraocular pres-

sure rises. Deposits on the posterior corneal surface increase, even though evidence of increased protein in the aqueous may decrease or even be biomicroscopically absent.

The diagnosis is important in that the intraocular pressure responds favorably to atropine or scopolamine and not usually to miotics, as the following case shows.

Case report. S. V., a 25-year-old man, was first seen by me on December 31, 1943. He had been entirely well until July, 1943, when he began to notice fogginess of vision, first in the left eye and later in both eyes.

Examination revealed a bilateral chronic granulomatous iridocyclitis. The visual acuity was: R.E., 20/30; L.E., 20/20. The tonometric readings were: R.E., 21 mm. Hg (Schiøtz); L.E., 60 mm. Hg. Both eyes were rather pale. Atropine (1 percent) was instilled into the left conjunctival sac three times daily. The response to cycloplegics was favorable, to eserine unfavorable as shown in Figure 1. The tension stayed normal from February 3, 1944, until a recurrence of the iridocyclitis appeared in June, 1946. This episode responded to scopolamine.

One other secondary glaucoma will be considered since some new thoughts concerning it have appeared. This is the secondary glaucoma associated with rubeosis iridis and following occlusion of the central retinal vein.

From the viewpoint of mechanism both of these are exactly the same.[11] The chamber angle early is open and shows the same newly formed vessels lining the angle and penetrating the angle wall. Later the angle becomes blocked by adhesion between the iris root and the trabecular wall.

The earliest case of this type I have seen was in a patient with one blind, painful, glaucomatous eye with diabetic rubeosis iridis, in whose other eye very localized small areas of rubeosis became evident near the pupil border and in a portion of the angle as the tension rose in that eye to 36 mm. Hg (Schiøtz). The angle was entirely open. The newly formed vessels lining the small areas of the angle could be seen penetrating the trabecular wall, presumably to anastomose with Schlemm's canal.

The occurrence of this condition in an eye with poor nutrition and hypoxia, as a result of severe vascular disease, suggests a causal relationship. The formation of newly formed vessels is stimulated, causing anastomoses with Schlemm's canal and in some way destroying its usefulness.

The treatment of this form of glaucoma is cyclodiathermy for the pain, or enucleation. The presence of the newly formed vessels may lead to spontaneous hemorrhages (hence the term hemorrhagic glaucoma). When surgical treatment is attempted, these vessels nearly always preclude success. I have recently seen a case of hemorrhagic glaucoma associated with rubeosis in a diabetic girl, aged 23 years. I know of no other such case in so young an individual.

Occasionally one finds a combination of two forms of glaucoma in the same patient. This has been described as mixed glaucoma.[11] Mixed primary acute glaucoma and glaucoma capsulare occur. Simple glaucoma and secondary glaucoma following central vein occlusion have appeared together. There may even appear a superimposition of primary acute glaucoma coincidentally on the background of a simple glaucoma.

Summary

A new classification of the glaucomas based on clinical evidence is suggested. The classification is arranged so as to include the same groupings into primary and secondary glaucoma which usage has made universal.

The diagnostic features of those forms of glaucoma where newer concepts have appeared are presented.

Emphasis is placed on routine tonometry in all patients 40 years of age or over to make early diagnosis of glaucoma simplex possible, since it is the most important ocular disease in relation to blindness, and one whose ravages can be prevented to a large extent by early recognition.

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SIGHT RESTORATION IN A SCHOOL FOR THE BLIND*

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Restoration or improvement of diminished vision is a different problem today from the one it was formerly. As is true in many other fields, conditions change. The diagnoses of pathologic conditions of the eye may remain the same, but the number of children within the various age groups who have eye afflictions is changing, thankfully, for the better.

As a marked example of percentage changes, the new cases entering schools for the blind approximated 3 percent last year due to gonorrheal ophthalmia neonatorum; whereas, 6 percent of new cases of this condition were noted in 1941; but contrast that with 28 percent in 1907! Other eye conditions will not respond with such remarkable speed, although a review of the eye records of pupils in schools for the blind throughout the country allows us to gain an excellent grasp of the many causes that now produce diminished vision.

I am indebted to the Committee on Statistics of the Blind for the information that the total number of pupils in schools and classes for the blind in America is 5,400. Of these, the records of about 3,700 children were studied for the school year 1945-46 when it was found that approximately 15 percent of the children are now blind because of cataracts which are largely of prenatal origin.

Discussion of sight restoration should include all phases of the handicapped individual's life and should not be limited to corrective eye treatment of pupils already enrolled in schools for the blind. It may be well to consider the subject under three categories: (1) prenatal care, (2) actual visual improvement, and (3) psychologic adjustment.

PRENATAL SIGHT RESTORATION

This grouping may be challenged by saying that it is a preventive classification but for the individual the end result by any name is the desired objective. The youngster who may have vision "restored" by an operation

* Presented at the conference of the National Society for the Prevention of Blindness, April 5 to 7, 1948, Minneapolis, Minnesota.

of any form, or by any sort of medical treatment is no more fortunate than the youngster who did not lose vision because his parents did not transmit the visual fault that is considered as a "prenatal" cause.

Those prenatal causes, such as syphilis or the acute eye infections known as ophthalmia neonatorum transmitted from the birth canal, have decreased nearly 40 percent and 25 percent, respectively, within the past 10 years. Such advances are due partly to the greater vigilance of the health officers and partly to the general education that is definitely and steadily being absorbed by all parents, by workers for the blind, by teachers, and by the general public.

It is important that this educational process be continued ceaselessly by varied means. Only by general education has it been possible to pass state or federal laws that emphasize maternal and infant care. Not only should we strive to have more babies live but also to have more babies see.

Medical research now helps by considering in a special category the congenital cataracts of babies born from mothers who had German measles during the early months of their pregnancy. Only since 1941, when a severe epidemic of rubella in Australia infected many expectant mothers with the result that their children showed a greater frequency of these congenital cataracts, has the entire condition been considered a separate entity.

The suggestion has been made that, in order to prevent such congenital malformations in the future, the prospective bride be required to indicate on application for a marriage license whether she has had German measles, just as, at the present in some states, it is required to have a physical examination for syphilis.

Restoration of sight should unquestionably include study of the prenatal causes of blindness. To add to the knowledge of what caused the blindness and how it might have been prevented is the biggest job of all and the one that gives the greatest amount of satisfaction.

Improving vision

The second division, that of actual visual improvement, would be an oft repeated story, were the operations to be listed, what they were, why they were done, and on whom.

The school for the blind in the state of Washington, for which I am the admissions consultant, had a survey and a thorough review, in 1942, by the American Foundation for the Blind. As a result of this examination of everything that pertained to the school, with the exception of the finances, many changes were made.

Several children were operated upon for cataracts or for other conditions to improve their vision. Some have been improved sufficiently to be removed from the school. However, the greatest improvement was gained by a number of children as a result of having been better fitted with glasses because of more frequent examinations or because special lenses, such as telescopic magnifiers, have been prescribed.

The survey not only opened the eyes of some of our youngsters but our eyes as well. It stimulated us to look around at other schools for the blind and showed that other schools had similar weak points. For example, it was found in our school, as well as in others, that some children were admitted without a preliminary or previous eye examination. Sometimes children did not have eye examinations yearly, or did not have more frequent eye examinations when progressive eye conditions, such as high myopia, were noted.

Today, all children vhose parents desire that they be admitted to the school for the blind are examined by an eye physician before the child is admitted to the school. In addition, the entrance eye examination reports are passed upon by the admissions consultant who is also the consultant ophthalmologist of the Blind Division, Department Public Welfare (incidentally a Board certificated man), who may deny entrance to any prospective youngster who is not blind.

All children are again examined by the

school ophthalmologist shortly after their entrance and again routinely yearly, even including those who have no eyes at all.

Returning sighted children to their homes

After review of our own past mistakes and our attempted corrections, we noted not only the faults relating to the medical needs but we perceived a weakness in our program covering the educational needs of the blind as well as the partially seeing child. We found our school well equipped and well developed for educational instruction along tactual methods. But the partially seeing pupils too often had been placed in the same classes as the blind, without regard to the better or more recent educational procedures or without regard to the utilization of visual media now available.

In spite of the acceptance of these partially seeing children, special educational facilities had not been provided. The partially seeing child had not had sufficient lighting for his greatly reduced eyesight. There had been an erroneous conclusion that the educational needs of the partially seeing and the blind were sometimes similar, sometimes identical—a conclusion manifested by certain types of vocational training that had been given to partially seeing students of the high-school age groups.

We found several children included in the school for the blind who had practically normal vision at the time of the independent, disinterested survey. Some eyes showed no reduction of vision, no intraocular or extraocular pathologic condition. The reasons for admittance of these children were: they were home-problem children; there was a mistaken recommendation made—sometimes by an optometrist and sometimes by a general practitioner; there was a broken home; or there was a suspected willful blindness in the child because a relative was blind, sometimes from some remote cause.

The attendance of these children at the school for the blind was easily remedied. What was not easily changed were the emotions, the attitudes, the living habits, the acceptance of the highly protective environment of the school, and the confusion that goes with returning these youngsters to their homes, sometimes against the will of their parents. This emotional shock of learning a second time that they are not wanted undoubtedly will have certain mental repercussions later.

A remarkable utilization of community resources was achieved when partially seeing as well as blind children participated in several play ventures with normal neighborhood children. Such activities included hikes, "wienie" roasts, and other youthful encounters dear to children everywhere. It was necessary for the superintendent of the school to initiate some of these activities, but after she realized that there had been isolation from neighborhood children, such problems ceased to exist.

Some children had been accepted by the school before a complete examination had been made by a competent ophthalmologist, before any corrective treatment had been attempted. It was obvious that the school accepted responsibility for which it was not prepared, and also that competent medical and adequate educational treatment had been delayed.

Our study revealed certain possibilities of improvement of the sight of the visually handicapped child by surgery, glasses, or some form of medical treatment. We endeavored to gain closer coöperation with our competent, associated eye physician so that whatever remaining vision the child had was maintained, safeguarded, and protected. But, what was more important to the youngster, he had more efficient use of his small amount of vision.

Two children, whose vision was improved from 2/200 to 10/200 by eye surgery undertaken after the survey showed the possibilities for such improvement, believed they should no longer read Braille, that they were not "blind children"—as indeed they weren't! They believed their better vision was adequate for all visual tasks of a seeing

person. Such visual improvement was not great as measured by our standards, but was sufficient for them to obtain an entirely new outlook on life, a new vision and acceptance of work, far beyond their previous abilities. Life for them was not blind, life was seeing.

In addition to the medical or surgical treatments, a re-allocation of the educational groups was done. Fifty percent of the children were kept in the same school but greater emphasis was placed upon visual methods rather than upon tactual procedures. Some children who had an absolute visual loss could not be changed. Ten percent of the remaining sighted children were placed in sight-saving classes, and about the same number were reconsidered for educational placement after corrective treatment had been done.

It was apparent that insufficient attention had been paid to the partially seeing youngster. Not enough attention had been devoted to each individual child so that he could gain full and complete value from the bit of sight that remained. Too often the youngster was given a routine treatment, was not considered as an individual. No one had attempted to probe the depths of personal differences nor to elicit the heights of personal abilities, which sometimes rose to an undreamed of level.

Psychologic adjustment

The last phase of sight restoration is often not classified as such, for there actually is no physical change. There is created no actual physical improvement. It is open to no statistical review. The changes in the person, however, are every bit as valuable and create just as much in the final review as if the person had received more vision. I am referring to the psychologic improvement within the mind of the individual.

Instead of permitting an unseeing child to remain huddled in the corner, our school for the blind has taken him out and put him into direct competition with children possessed of all five senses. For example, one boy, after receiving artificial eyes, could not believe that seeing people on casual inspection would think that he, too, was like them. He was told time and again that no one knew he had artificial eyes. No. He must have that point proved for himself, by himself.

Wearing both eyes, he went into a men's haberdashery, the best one in that city, and asked for a blue tie. He examined a few ties carefully and then asked for a different darker shade. After looking over the second group of ties, he said that none of them seemed to be the correct shade, that he would search elsewhere for a slightly different color, then left the store.

That experience, a few years ago, was all the boy needed. Now he wears his artificial eyes and is making an excellent social adjustment, just as he is making a satisfactory living by selling books. Almost as much has been accomplished as though more vision had been given.

One girl won her sectional high school oratorical contest—in spite of the fact that she had no eyes. Another boy attends a high school in the same town where the school for the blind is located. He competes with sighted students throughout the day, but his lessons are read to him at night. His grades are entirely acceptable. He goes with the high school athletic teams and attends every game, home or afield. He plays a large horn, marches in all the parades, and is accepted by his fellow students.

This boy has encountered only one minor difficulty—that of marching in parade and drill formation. Even that point was solved by running a fine piano wire from his belt to his adjoining companions. He was forced to that solution one day when his companions turned a corner. He didn't turn, but continued marching straight ahead. Now, when his companions turn a corner, now when the world turns a corner, he turns too, confident of success.

Sight restoration can be of still greater, more widespread benefit than it is today when we realize its full import, its greatest possibilities.

Stimson Building (1).

NOTES, CASES, INSTRUMENTS

"TO BALANCE" LENSES

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The patient was a 14-year-old, auburn-haired, white girl. She gave the history of having pierced the left eyeball with sharp scissors several months previously. The eye was hopelessly damaged and was enucleated elsewhere with the implant of a 16-mm. metal ball into the bulbar fascia. The ball extruded, and was replaced. It extruded again. The original surgeon had suffered a heart attack and was unable to continue with the case, so an interne replaced the ball. In all it extruded five times in less than a year's time.

The socket was markedly shrunken and drained a purulent material constantly. The patient was able to insert only an infant-size prosthesis and, because of the cosmetic disfigurement, preferred to wear a gauze eye-pad. She avoided social activity and felt her disfigurement keenly. She presented herself with the hope that her condition could be corrected.

Eye examination revealed a normal right eye and orbit. A moderately contracted left socket contained a large amount of creamy pus. The skin of the left eyelids, orbital margins, and cheek was badly excoriated. After cleansing the orbit an extensive spider-shaped scar was seen posteriorly in the center of the socket with arms radiating to the cul-de-sac in all directions. The pus oozed from a small ostium in the center of the scar.

Brief exploration at once revealed a small black foreign body which on removal proved to be the end of a 3-cm. fragment of black silk. Saline irrigations of the socket and a bland ointment for the skin were advised. Within a few days the discharge had stopped.

Operation. Since the socket would not accept a satisfactory prosthesis, it was decided to restore it to adequate size with a mucous membrane implant. The girl was nervous and uneasy after her numerous orbital manipulations, but preoperative sedation and local anesthesia were adequate.

The arachnoid scar was dissected out along all of its ramifications, leaving the anterior orbital tissue soft and distensible but lacking much membranous surface. A lateral canthotomy was thought necessary.

The remains of the bulbar fascia were located and the cavity was dilated to adequate size with a large hemostatic forceps. A 16-mm. glass sphere was introduced into the bulbar fascial space and the opening was closed with a 3-0 plain catgut purse-string suture. Bits of surrounding fibrous tissue were imbricated across the purse-string to bury and strengthen the closure.

Hot wet packs were inserted into the socket while the graft was prepared. This was obtained from the lower lip, which throughout was held strongly stretched. An area, 2.5 cm. by 3.5 cm., was outlined and removed in full thickness with a Graefe knife.

The edges of the lip defect were undermined and closed with interrupted black silk sutures; the lip healed rapidly and uneventfully although most of the sutures loosened and were unknowingly swallowed with the food.

The deep face of the graft was carefully denuded of all bits of fat, and the graft was stretched over a prepared and waxed sterile elliptical piece of cardboard cut to size. A small hole had been punched through the center of the cardboard stent to permit possible drainage. The stent was inserted so that the two raw, dry surfaces were apposed. A vaseline gauze pack was snugly forced into the socket. A pressure bandage was applied for 10 days.

At the end of this time the pack was re-

moved, the silk suture clipped, and the stent gently withdrawn. There was considerable foul discharge but, upon cleansing, the graft was seen to be in situ and healthy. The socket was filled with penicillin ointment and the largest possible perforated plastic conformer was inserted. The conformer extruded over night, so it was replaced by a smaller one.

Outcome. The socket healed uneventfully except for one heavy adhesion which had formed under the canthotomy; this adhesion was severed and an effort made to hold the raw surfaces apart with a larger conformer. This failed, so a second graft of mucous membrane was secured from the right cheek, and attached to a stent, and the lateral cul-de-sac was thereby reëstablished.

The resultant socket was healthy and of adequate size but somewhat irregular in shape. Prostheses taken from stock were unsatisfactory, so a special plastic prosthesis was made with an irregular flange trimmed to fit the fornices. After numerous attempts, the prosthesis makers did a beautiful job in matching the opposite eye, and I readily agreed that they had created a masterpiece.

Refraction. The "good" eye was then refracted, with the intention of advising glasses as a protective measure regardless of the optical needs. However, she did need a moderate correction. With the prosthesis, the trial frame, and the right prescription in place I studied her cosmetic effect carefully.

The artificial left eye had a slightly prominent, staring effect, which was found by trial and error to be reduced to normal by a −4D. sph. This, however, made the interpalpebral fissure appear a trifle too short. By trial and error again, it was found that a +2D. cyl. ax. 90° gave the illusion of lengthening the fissure correctly. From the side view her appearance was satisfactory except for a slight retraction of the upper lid.

It was believed that boldness in frame style would draw attention to the frames rather than the eyes, so a gayly decorated frame popular with the teen-age group was selected, a style being found which had a temple to conceal her slight lid retraction.

Result. The result was highly gratifying to all concerned. The young woman has taken a new lease on life, attending parties and public functions with a restored and delightful self assurance. A number of new friends still do not know that she wears an artificial eye, and older friends congratulate her.

Discussion

I have abandoned the custom of prescribing "to balance" lenses before prostheses. I seek instead the prescription which will create the most natural illusion in front of the prosthesis and insist that the opticians grind the lenses as ordered.

Sunken prostheses can be "brought forward" by application of plus spheres. A prominent or staring prosthesis can be minified and recessed by a minus sphere. A palpebral fissure which does not match its fellow can be lengthened, shortened, widened, or narrowed by the use of appropriate cylinders at appropriate axes.

The lateral or profile appearance can be markedly enhanced by a judicious choice of frames and temple positions. The retracted upper lid can be concealed by a high temple. Poor lateral motion of the prosthesis can be minimized by a centrally placed temple. A retraction of the trochlear area can be improved by an oblique cylinder. Prism is justified to elevate a sagging prosthesis.

As a general rule, plastic frames do more to create a cosmetic illusion, particularly if they are fairly massive and have strong color or accents. The frame width should usually be kept more narrow than one would customarily use, since the concealment effect is better.

Probably many hundreds of cases would lend themselves yearly to this cosmetic consideration. One patient with von Recklinghausen's disease and profound distortion of the left orbital area was similarly pleased by a careful choice of glasses. He needed a

minor correction for the right eye, so a pair of very massive frames carrying moderately tinted lenses was chosen. A special left temple was decided upon because of his deformity, and he was given both psychologic and cosmetic benefit. Since the left eye was useless, bulging tissues were minified by a minus sphere.

Blind, staphylomatous eyes can be made less obvious by minus spheres. Blind shrunken eyes can be tried with plus spheres. Tinted lenses can be used where needed without detracting from the effect. It is possible to put a light shade over the "good" eye and a somewhat darker shade over the other with hardly noticeable effect.

I claim no originality for these thoughts; they have all been suggested and tried by others. However, investigation has shown that many ophthalmologists have never considered nor even heard of these simple cosmetic aids. I feel that results can be so gratifying that this small detail deserves studied consideration in every suitable case. Let us abandon the "to balance" prescription!

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A MODIFIED TECHNIQUE OF TARSORRHAPHY*

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The value of tarsorrhaphy in indolent corneal conditions, in muroparalytic keratitis, and in plastic surgery needs no mention. The standard technique of tarsorrhaphy both as described in textbooks and practiced involves a loss of tissue (freshening of the lid margins—Wheeler; cutting out planned areas of tarsal plate—Elschnig) and, unless this removal of tissue is carried out fully, the tarsorrhaphy fails. This loss of lid tissue in temporary tarsorrhaphies is a great disadvantage because of the lid deformities that are sometimes caused.

* From the Oxford Eye Hospital.

Technique

I have been able to modify the technique slightly, so that there is no taking away of tissues and no chance of failure. I have been practicing this technique with success for over three years. I hope it will appeal to other colleagues and will be given a fair trial.

The instruments required are: (1) 2-cc. hypodermic syringe and needles for infiltration; (2) lid clamps; (3) Beer's knife; (4) black silk (4-0) on No.-3 needles; (5) short length of 1-mm. rubber tubing; (6) needle holder and forceps.

Preparation. The skin of the lids is prepared in the usual way. The lashes may or may not be cut; it is an advantage not to cut them.

Anesthesia. Local anesthesia of conjunctiva is obtained by 4-percent cocaine or any other substitute (anethaine, and so forth). Both the lids are then infiltrated with a suitable infiltration anesthetic. I usually use Novatox. For median tarsorrhaphy and complete tarsorrhaphy, a few drops should also be injected along the medial wall of the orbit.

Operation. With the usual aseptic precautions, one of the lids is held in the clamp firmly. I usually start with the lower lid first. The gray line is then defined, and an incision made along it, separating the tarsal plate from the skin and orbicularis. The length and site of this incision will depend on the length and site of the lid occlusion required. The separation of the tarsus is carried out to about one third of its width; that is to about 3 mm. from the margin (fig. 1). The clamp is now applied to the other lid, and a similar splitting of the lid is done.

A continuous mattress suture is now inserted, biting the pretarsal tissues (fig. 2). The suture is drawn tight, but the ends are left free. This brings the two tarsal plates together at their edges and covers the eye.

The free, lash-bearing edges of the lids are now sutured together with interrupted mattress silk sutures (fig. 3). These sutures

are drawn through 3-mm. lengths of the rubber tubing and tied tight (fig. 4).

The lids are now cleaned and dressed with penicillin Tulle Gras. The dressing is changed in 48 hours, when the continuous pretarsal suture is pulled out. The new dressing is left on for 6 days, and the skin stitches are removed at the end of that period.

Postoperation anatomy. The lash-bearing margins of the two lids are directed anteriorly. The orbicularis fibers of the two lids are united together by fibrous tissue; the union is about 2-mm. wide and is along the whole length of the operated area.

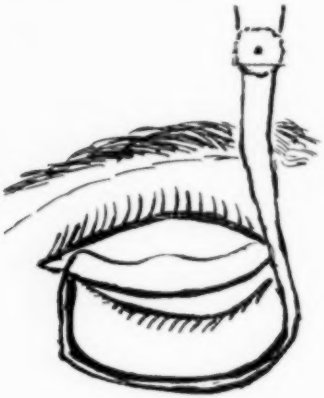

Fig. 1 (Sarwar). Holding the lid firmly in the clamp, an incision is made and the separation of the tarsus is carried out to about one third of its width.

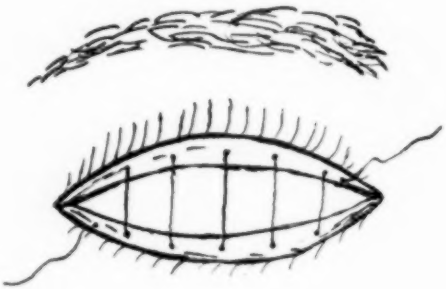

Fig. 2 (Sarwar). A continuous mattress suture is inserted, biting the pretarsal tissues.

Discussion

The operation is very simple to do and requires very few instruments. The lid clamps can be dispensed with if not readily available.

It does not involve removal of any tissues —a point of considerable importance in temporary tarsorrhaphy.

It does not interfere with the anatomy of the tarsus—another important point in temporary procedures. When a temporary tarsorrhaphy is undone, the skin and tarsus unite together again in their natural state, with no residual deformity of lid margin.

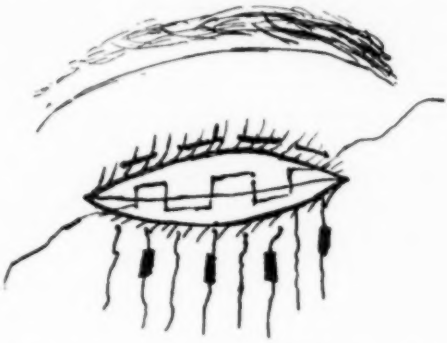

Fig. 3 (Sarwar). The free, lash-bearing edges of the lids are sutured together with interrupted mattress silk sutures.

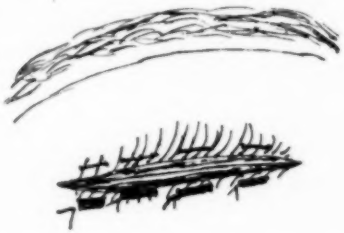

Fig. 4 (Sarwar). The sutures are drawn through 3-mm. lengths of rubber tubing and tied.

The union of the two lids is by connective tissue and about ½ to 1 mm. behind the lash-bearing area, the two rows of lashes diverging from the line of union, and curving up and down respectively. The cosmetic effect

in a total tarsorrhaphy, although strange, is not unpleasant as with the more usual procedures. For the same reason the cosmetic effect is definitely superior in partial tarsorrhaphies, the eye acquiring a "dreamy" look, rather than the "tampered with" appearance of the usual procedures. The presence of the lashes hides the scar of union, too.

The greatest advantage, however, is the permanence of the procedure. It is permanent because the union is a fibrous one between the orbicularis muscle fibers, and there is no tension on the skin.

In cases of muroparalytic keratitis, the lid sutures should not be tied too tightly, or else the already atrophic skin might die and slough away, causing a scar.

I wish to record my thanks to Mr. J. P. F. Lloyd, the senior surgeon, for his constant encouragement in this and other work.

USE OF PRIVINE-ANTISTINE DROPS IN OPHTHALMOLOGY*

RAY K. DAILY, M.D.,
AND
LOUIS DAILY, JR., M.D.
Houston, Texas

This is a combination of two drugs,† Privine and Antistine.

Privine is chemically a naphthyl-methyl-imidazoline hydrochloride. It is a crystalline colorless substance soluble in water and in saline solution. The solution is stable and is not decomposed by exposure to light or air. Its pharmacologic properties were described in 1941 by Meier and Müller.

Instilled into the conjunctival sac it produces a vasoconstriction similar to that of adrenalin; it lasts longer and there is no secondary vasodilatation. The blanching of the conjunctiva sets in rapidly, lasts about 2 to 3 hours, and then slowly recedes; it acts principally on the small conjunctival vessels. The effect on the larger vessels and on the ciliary and episcleral vessels is less pronounced.

It is a sympathetic stimulant and produces a slight widening of the palpebral fissures through contraction of the musculus tarsalis superior. It also produces a perceptible pupillary dilatation by its effect on the dilator pupillae. The mydriasis is noticeable only in dim light and in eyes with blue irises. In daylight and in brown eyes the mydriasis is uncertain. It disappears in several hours and does not cause dazzling. The pupillary reactions, accommodation, and corneal sensitivity remain normal.

The effect on the intraocular pressure is insignificant. Bürki[2] in the report of his clinical investigations states that he did not see a single case of a rise in intraocular pressure. Fanta[3] of the Lindner Clinic found a few cases in which the instillation was followed by a brief and insignificant increase in tension.

Antistine, a synthetic antihistaminic drug, is a crystalline, white odorless powder, the chemical formula of which is phenyl-benzyl-aminomethylimidazoline. Its sulphate, used for the ophthalmic solution has a pH of 6.9. It is prepared in an isotonic buffered solution with the following formula—antistine sulphate, 18.75 gm.; sodium carbonate anhydrous, 2.66 gm.; potassium chloride, 27.75 gm.; boric acid, 46.50 gm.; distilled water, 3,750 cc.

Bourquin[1] reported on the use of this solution in 37 cases of various types of conjunctivitis and scleritis. He found that its instillation relieved photophobia, itching, and lacrimation, and was of value in giving symptomatic relief, although it had no permanent effect on allergic conditions.

A combination* of 0.5-percent Antistine with 0.025-percent Privine has been used by us in about 100 cases of various types of conjunctivitis.

* From the Department of Ophthalmology, Baylor University College of Medicine.

† Manufactured by the Ciba Pharmaceutical Products, Inc.

* Supplied for experimental purposes by the Ciba Pharmaceutical Products, Inc.

Its vasoconstricting effect and its calming action on blepharospasm make it useful in a number of conjunctival and corneal diseases. The effect varies in different patients, both as to intensity and duration. Its instillation produces a short transitory smarting sensation. One patient with keratoconjunctivitis sicca, on whom it was tried, complained that after the instillation of the solution the eyes burned for a considerable period of time, but that the eyes were very comfortable for some time afterward.

The solution is particularly suitable for cases characterized by conjunctival congestion. It is used gratefully by patients who complain of burning, itching, photophobia, lacrimation, or dryness, a sensation of sand in the eyes, fatigue and blurring of vision, particularly in the evening.

In most of these patients the objective data are not commensurate with their subjective symptoms. In many cases there is no objective pathologic condition; the conjunctival scrapings are negative for microörganisms; the lacrimal passages are normal; the refractive error is corrected.

In some cases there is a mild subacute or chronic conjunctivitis with moderate redness and swelling of the palpebral and fornix conjunctiva. Occasionally, there is more pronounced conjunctival hyperemia and infiltration with a few follicles. In such cases instillation of Antistine-Privine drops every four hours brings prompt subjective amelioration. The alleviation of subjective complaints is superior to that obtained from the instillation of weak zinc sulphate, resorcin, or mercury oxycyanide, the medicaments which usually give transitory relief to such patients.

Since Antistine-Privine solution may be used indefinitely, it is a useful addition to our list of medicaments for chronic conjunctivitis. It is appreciated by patients with allergic conjunctivitis, who complain of photophobia and lacrimation. In eczematous keratitis, it is said to reduce the inflammatory symptoms by decongestion of the conjunctiva, and to diminish the corneal vascularization with a salutory effect on the visual outcome.

The solution may be combined with astringents in chronic conjunctivitis, or with silver preparations in acute conjunctivitis. In scleritis and episcleritis the bulbar congestion is reduced, and the patient gets a sense of subjective improvement, but the effect is not as pronounced as it is in conjunctivitis. It is also useful for the relief of postoperative discomfort due to persistent conjunctival hyperemia.

In persistent conjunctival irritation following trauma, burns, and chemical injuries, the instillation of the drops causes a blanching of the conjunctiva, and gives the patient a sensation of relief. In combination with local anesthetics, such as pontocaine or holocaine, it reduces the conjunctival irritation frequently produced by these anesthetics. This is an advantage when repeated applications are necessary, as in taking tension curves. It can also be used in place of adrenalin instillations in surgical procedures.

Summary

The combination of Antistine-Privine drops is a valuable addition to our therapeutic armamentarium. Instilled into the conjunctival sac it produces a rapid decongestion of the conjunctiva, which is agreeable in a number of conjunctival conditions.

Medical Arts Building (2).

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ACCIDENTAL CYCLOPLEGIA BY JIMSON WEED

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The solanaceous plant, Datura stramonium, also known as Jimson weed, stink weed, Jamestown weed, is widely distributed in the United States and in many parts of the world. Containing mainly hyoscine, it has been used since the earliest times for its systemic effects. Tradition has it that this was the drug given to the person delivering the oracle in the Temple at Delphi.[1]

During the summer and fall small children playing in the gardens and woods are attracted by this large weed and its fruit, and, mistaking it for some edible fruit, eat it in relatively large amounts. Although there are many reported cases of either accidental or criminal poisoning by ingestion of stramonium every year, there are only seven reported cases of accidental cycloplegia in the world literature during the past 50 years; 3 in the United States,[2, 3] 1 in Cuba,[4] 1 in France,[5] and 2 in French Morocco.[6] All occurred in adults.

It is my suspicion that there are many more cases of sudden unexplained cycloplegia (and mydriasis) that are caused by parts of the leaves and seeds of the Jimson weed getting into eyes.

CASE REPORTS

The following cases occurred in children.

Case 1.† A very intelligent, 11-year-old girl was recently brought into the eye clinic of Gallinger Municipal Hospital because of sudden loss of vision in the right eye. The girl stated that while playing in the nearby woods the previous afternoon she had kicked at some tall weeds and that the large pods on the plant had burst showering her head with seeds. In shaking them off something had gotten into her right eye. That evening she complained to her grandmother who thereupon found and removed a small black seed from the eye.

The next morning the patient noticed the blurred vision in the right eye and her grandparents noted the dilated pupil. She was brought to the clinic that afternoon. The child brought a segment of the weed complete with pods and the grandfather volunteered the information that the plant was very common in the vicinity and was known as the Jimson weed.

Ocular examination revealed mydriasis and cycloplegia of the right eye. Within 48 hours the pupil and accommodation had returned to normal.

Case 2. Three weeks previously, a 12-year-old boy had been examined. The same type of condition was presented, and it followed the same course. Here, no explanation could be obtained of the phenomenon, the parents stoutly maintaining that no eye drops were ever in the house. The strongest suspicion now points to the Jimson weed as being the offender.

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† Service of Dr. William D. Foote.

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SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

SECTION ON OPHTHALMOLOGY

March 18, 1948

DR. ALFRED COWAN, *acting chairman*

INDICATIONS AND RESULTS IN KERATOPLASTY

DR. HAROLD G. SCHEIE reported the results obtained from 22 corneal transplant operations performed at the Hospital of the University of Pennsylvania. Nineteen of the eyes were followed through convalescence and the statistics presented were obtained from these, although it was realized that the number was too small to be of statistical significance. The cases were classified according to Castroviejo's prognostic grouping from Group I, the most favorable, to Group IV, the least favorable.

Three criteria were used to judge the success or failure of the operation: (1) clarity of the graft, (2) improvement in visual acuity, and (3) benefit to the patient.

Six eyes operated were of Group I, including those having a central corneal scar from old keratitis, keratoconus, and one having central scars from interstitial keratitis. All of the patients in Group I obtained clear grafts and improved visual acuity which was very striking in three. When improvements did not result, amblyopia ex anopsia or central scotomas offered the explanation.

The criterion of actual benefit derived from the operation by the patient offers an even more critical and possibly more practical way of evaluating corneal transplantation. In spite of clear grafts and visual improvement in all, only 4 of the 6 patients used the operated eye, thus deriving benefit from the procedure. The astigmatic error varied from 2 to 5 diopters.

Only 3 of the 4 patients in Group II have completed their convalescence. Two of these 3 have clear grafts. All have rather remarkably improved vision, but only 2 of the 3 obtained real benefit from the operation, the third not using his operated eye.

There were only 2 patients in Group III. The first patient had been suffering from recurrent corneal ulceration with severe discomfort for three years. He had reached the point where he preferred enucleation of the eye rather than further discomfort.

The involved area of the cornea was central. A corneal graft was done which remained clear and has made him more comfortable. There was no visual improvement, however, because of a complicated cataract which had been present before operation. He should have a good eye following the extraction.

The other patient had central scarring from an old keratitis, but the lens had been subluxated by a former injury, and was cataractous. A transplantation was done in the hope of giving him a clear cornea before cataract extraction, but the graft became opaque, and he has definitely been made worse by the operation.

Group IV included 8 patients with severe corneal conditions such as epithelial dystrophy, severe corneal degeneration as a result of interstitial keratitis, extensive mustard burns of the cornea, and one recurrent ulcerative keratitis with calcareous degeneration.

Only 1 of these has a clear transplant, and 3 obtain significantly improved vision. However, from the standpoint of benefit to the patient, 4 of the 8 have been dramatically improved either visually or through alleviation of symptoms. The most dramatic was that of a soldier with bilateral severe mustard burns of the cornea. Only 1 patient, who developed an iris prolapse with eventual loss of his eye, was made worse by the procedure.

Taken as a whole, visual improvement

was obtained in 65 percent of patients. Fifty percent of the grafts remained clear. From the standpoint of benefit to paients, 56 percent of the patients were benefited by the operation. Thirty-one percent were unimproved and 10 percent were made worse, although this is difficult to say since their vision had been hand-movements and light perception respectively before operation. Since 8 of the patients operated were in Group IV, the overall figures are not displeasing.

The indications followed for corneal transplant were:

1. Favorable conditions of Group I and Group II are preferred, but whenever a patient has a chance of some visual or symptomatic gain and nothing to lose, corneal transplantation can justifiably be done.
2. Vision should be less than 6/60.
3. Hesitation is advised in unilateral involvement.
4. A one-eyed patient should be operated only if his eyesight is of no practical value to him.

Discussion. Dr. James S. Shipman: I would like to congratulate Dr. Scheie on this excellent and very honest presentation of a most interesting subject. Indeed the picture of keratoplasty, as given here tonight, is very different from that we see given to the public too often in the newspapers. I think it is too bad that the subject cannot be presented to the public, through the newspapers, in its true light.

The actual cases as presented here tonight are evidence of the excellent technique followed by Dr. Scheie. Indeed they are very convincing for the circular type of transplant.

One of the cases presented here tonight happens to be that of a patient on whom I did a corneal transplant about six years ago. At that time we used the double-bladed knife of Castroviejo and obtained a square graft. In this case everything went well until about a week after operation, when the patient developed a secondary glaucoma. This was eventually controlled with miotics. I notice that Dr. Scheie encountered this complication only once in his series of 20 cases.

The patient of whom I speak had presented a most severe case of interstitial keratitis. A short while after operation he developed a marked increase, and overfilling, of old corneal vessels. As a result of this, the corneal graft went on to complete opacification. We had given this patient numerous X-ray treatments recently with the hope of blocking off the corneal vessels, and had planned to try a second transplant. I am very happy to see that Dr. Scheie has done this, and I hope that his results are satisfactory. I also hope that he will do a similar operation on the other eye which is less scarred and vascular and offers a better prognosis.

Indeed after seeing the cases presented here to night I feel that Dr. Scheie is to be complimented on his beautiful technical results, and I am sure that, with more favorable cases, the visual results will be better.

Again I wish to say that this paper has been most instructive and enjoyable.

Dr. W. E. Fry: There are a number of interstitial keratitis cases at the Overbrook School and, in breaking down some of the statistics in regard to them several years ago, the general outlook was poor in regard to corneal surgery. Many of the patients showed evidence of severe anterior uveitis and, when the fundus was visible, showed optic atrophy.

There is one point that I think might be added to the discussion, and that is we probably do not know the full story in regard to how the transplant acts as a foreign body in the cornea. The reason why I make the statement is this—one youngster with an interstitial keratitis on whom I did a transplant on both eyes had a 6/9 vision in one eye following surgery, and has maintained this vision for over one year. Six months later I did the second eye with exactly the same technique with no complications whatsoever. The result was a partially opaque cornea

ıd 6/60 vision. I cannot explain the differ- ·e. I wish Dr. Scheie would explain it to ·. I think there is something we do not know in regard to the way in which we select our donor material.

Dr. Hunt: It has been my privilege to look at all of these cases that Dr. Scheie has done, I believe, and follow them through, and while the procedure is not technically too difficult, anyone who is not prepared to do very thorough and meticulous after care should not attempt the operation.

I believe Dr. Scheie mentioned there were some 60 complications in this series. From his discussion, I think we can evaluate this as being a practical, useful procedure that should be tried in favorable cases.

Dr. Louis Lehrfeld: The oldest case of corneal transplant that I have on record is one dating back to the year 1940. This case was one of keratoconus in which the transplant was regarded as quite successful. The patient's vision was partially restored by the transplant. The patient, who was seen by me and my associate only a few weeks ago in the clinic, now has keratoconus recurring in the transplant itself. I mention it, because I think that those who are now doing the transplants should keep in mind the fact that mere transplantation of a good cornea to take the place of an old one does not necessarily change the fundamental pathology underlying keratoconus. That does not mean necessarily that one should be discouraged in doing this type of operation for keratoconus or for any other cause.

The essayist has suggested to you various types of corneal lesions for which he would propose to do a corneal transplant. Of course, it has been said facetiously and I have heard the remark passed many times at conventions, that when you get good transplant results it might have been possible to get similar results by doing something else instead of the transplant. I would like to encourage further experimental work in transplants because the future holds much for it. Despite the fact that there are many disappointments and many unusual cases of improvement, I feel that in the future many more cases, even in Groups III and IV, will be successful.

Dr. Harold G. Scheie (closing): I wish to thank all of the discussors. Vascularization of the transplanted cornea is the biggest problem with which we have to deal. The explanation for this vascularization has always been obscure, but might be derived from the experience of the general plastic surgeon who finds that skin transplanted from one individual to another apparently takes well for approximately three weeks. After this time it exfoliates and is lost, not being tolerated by the recipient's tissues.

It is at about this same time interval that eyes on which corneal transplantation has been done become red; the graft tends to become cloudy, and blood vessels invade the cornea. This reaction and vascularization is less severe in corneas where vessels have been minimal preoperatively.

On the other hand, if the cornea was heavily vascularized beforehand, the eye seems to do well for about 2 to 3 weeks, then becomes inflamed and the graft rather rapidly vascularizes. The transplants, as a result, become opaque in a rather large number of cases. The reaction of the recipient to tissues from another of the same species might well correlate with the number of preëxisting vessels into the recipient bed, the tissue responses being greater where vascularity is excessive.

Some observations on miotics

Dr. Edwin B. Dunphy of Boston (guest speaker).

This paper appears in full on page 399 of this issue of the Journal.

Discussion. Dr. Francis Heed Adler: I think we are all very appreciative of the able way in which Dr. Dunphy has covered this entire field in both the theory and practical use of miotics. The point he brought out about mecholyl is evidence that the increased pressure in glaucoma damages the post-

ganglionic fibers so that the myoneural junction becomes sensitive to cholines.

Dr. Scheie has previously reported the experimental production of sensitivity to mecholyl in cats by artificially raising the intraocular pressure for short periods of time. It is generally supposed that such sensitization does not occur until nerve fibers have degenerated and, if this is so, one would hardly expect mecholyl to be of use in an acute glaucoma when the attack has lasted only an hour or so. Actually, it seems to be effective in this condition, and this, combined with Dr. Scheie's experiments, suggests that it is not necessary for nerve degeneration to take place in order to produce sensitivity.

Dr. Irving H. Leopold: This paper represents one of the best summaries of miotic therapy in glaucoma and of pharmacologic data on miotics.

I was very interested in Dr. Dunphy's discussion about T.E.P. triethyl-pyro-phosphate. In 1934 there was an epidemic of diarrhea and peripheral palsies in the inhabitants of one of the islands of the West Indies, and for a long time they were perplexed as to the etiology. It was then found that these individuals were eating or working with Jamaica ginger, and I believe one of the compounds which was extracted from the ginger was tri-ortho-cresyl phosphate. This was found to have marked anticholinesterase activity by some Swedish workers just a few years ago. It may be that this drug or one of its derivatives also might merit evaluation in ophthalmology.

Dr. Dunphy considered the question of synergism of cholinergic and anticholinesterase drugs. It is interesting to consider the effect of combining two anticholinesterase drugs such as eserine and D.F.P. It can be shown that eserine blocks the action of D.F.P.

A series of animals were injected with D.F.P., and the minimal lethal dose of D.F.P. that will kill about 50 of every 100 animals was determined. If another series of the same animal were given a sublethal injection of eserine, it was found that the previously used dose of D.F.P. no longer killed those animals. In other words, eserine had protected the animals from the lethal action of D.F.P.

The same phenomena can be demonstrated in the eye by instilling a drop of eserine in one eye of an individual, wait until the maximal miotic effect has occurred, which usually takes about 15 minutes, and then instill a drop of D.F.P. in each eye. The eye which has received eserine comes back to preinstillation size in about 2 to 3 days. The eye which has received D.F.P. alone remains miotic a week or two, the usual length of time for the D.F.P. miotic effect.

Now what about the reverse effect, that is if D.F.P. is used before eserine? The sublethal dose of eserine is determined. That is the intramuscular dose that just fails to kill. Animals are given an injection of D.F.P. in a similar sublethal dose. Following this the previously determined sublethal dose of eserine is injected. The eserine injection now results in the death of most of the animals.

In other words, D.F.P. does not prevent the action of eserine. Actually, when eserine is given after D.F.P. there is a combined effect.

One of the experiments that interested me was the one that employed the ingenious method of instilling eyedrops in the dark. The observation that D.F.P. did constrict the pupil of the dark-adapted eye does not mean that D.F.P. has a direct effect on iris musculature, but simply that even the dark-adapted eye produces acetylcholine that can be preserved when D.F.P. ties up the cholinesterase.

This was certainly a very enjoyable paper.

Dr. I. S. Tassman: I would like to make one or two remarks in connection with Dr. Dunphy's observation, particularly regarding the increase in intraocular pressure following the instillation of these miotics, and also regarding the effect on the vessels. I have under observation at the present time at

Wills Hospital one case in which we noted an increase in the intraocular pressure following the instillation of mecholyl and neostigmine and, in addition, the lens in the affected eye was pushed so far forward that the anterior chamber was almost entirely obliterated.

I also recall another case in which we observed an increase in the intraocular pressure following the use of D.F.P.

It is interesting to speculate as to the mechanism by which the intraocular pressure is lowered by these drugs. As was pointed out, I think also that there are certain differences in the action of these various drugs when they are employed in certain combinations. This is probably true of those in the adrenergic group, as well as those belonging to the cholinergic group. Some time ago, I think Dr. Cogan published an article in the *Archives of Ophthalmology* which had something to do with the dual intervention of the ciliary body. In that paper I believe Dr. Cogan referred to the use of these miotics. In another article, I believe it was by Myerson and Thau, speculation was made as to the possibility of an overaccumulation of the esterases with oncoming age to explain the occurrence at that age of presbyopia.

A fair amount of progress has been made since the work of Loewi and Englehart, Cogan and others, but the mechanism is still quite complex, as Dr. Dunphy pointed out, and as yet not fully understood. I think that Dr. Dunphy should be congraulated for this very comprehensive, interesting, and practical paper. It has been a great pleasure to hear it.

Dr. Edwin B. Dunphy (closing): I was very much interested in what Dr. Leopold said about the eserine and D.F.P. combination.

There is very little for me to say, Mr. Chairman, except to thank you again for your invitation.

M. Luther Kauffman,
Clerk.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

March 1, 1948

DR. DANIEL KRAVITZ, *president*

VISUAL FIELD STUDIES IN NEURO-OPHTHALMOLOGY

DR. MAX CHAMLIN discussed this subject during the instruction period.

PUPILLARY ABNORMALITIES ASSOCIATED WITH INTRACRANIAL LESIONS

DR. ABRAHAM RABINER said that a neurologic examination is never complete without careful study of the pupils. A dilated pupil may be the only clue as to the hemisphere affected by subdural hematoma or other type of expanding intracranial lesions. That abnormal pupillary responses to light may be the only objective evidence of central nervous disease syphilis has long been known. The Horner syndrome often localizes the pathologic process at the cervical cord level. This occurs also in lesions of the medulla and of the lung apex.

The wide-open, staring eyes and dilated pupils of the panicky individual may be compared to the exophthalmos in the goiter patient. The mechanism controlling pupillary innervation is highly labile. The autonomic nervous system may be regarded as the neural apparatus determining the instinctive somatic reactions to each bit of life experience. All stimuli producing emotional reactions travel through the sensorium up the spinal cord or through the other perceptive pathways to the brain stem, the basal ganglion structures, and the cerebral cortex and also travel with the vascular tree.

It seems obvious, therefore, that it is not justifiable to speak only of centers where lesions produce a Horner syndrome. It is more accurate to think of pathways conducting stimuli that are either interrupted or stimulated. Such stimuli may be of a structural organic nature but often are psycho-

genic. Life itself and its kaleidoscopic events frequently affect the nervous system and amongst other symptoms produces alterations in the appearance and reactions of the pupil.

Alterations in extraocular movements resulting from intracranial lesions

Dr. E. Jefferson Browder said that the aneurysms arising from the intracranial portion of the internal carotid artery, those budding from the arteries comprising the circle of Willis, and those of the basilar artery and some of its branches, often impinge upon and produce dysfunctions of the third, fourth, and sixth cranial nerves. Other aneurysms not adjacent to those nerves may produce extraocular palsies secondary to rupture into the cerebral subarachnoid space or into the cerebral substance, with massive clot formation.

Dr. Browder said that an analysis of the symptomatology and abnormal physical signs with particular reference to extraocular palsies indicates that six different syndromes may be recognized:

1. The syndrome of rupture of the aneurysms of the internal carotid artery as it traverses the cavernous sinus or the carotid-cavernous fistula.

2. The syndrome of the aneurysms of the second part of the sigmoid of the internal carotid. The intracranial epidural fusiform aneurysms.

3. The syndrome of the aneurysms of the subdural portion of the internal carotid artery.

4. The syndrome of the aneurysms at the bifurcation of the internal carotid artery and those of the posterior communicating artery.

5. The syndrome of intrancranial hypertension resulting from aneurysmal rupture (spontaneous subarachnoid hemorrhage and/or intracerebral hematomas).

6. The syndrome of fusiform aneurysms of the basilar artery.

While it is recognized that all abnormal features must be given consideration in any example of intracranial aneurysm, a correct interpretation of the disturbance in the ocular mechanism plays an important role in the localization of such a lesion.

Monocular and binocular palsy of gaze

Dr. Alfred Kestenbaum said that horizontal palsy of gaze or palsy of lateral parallel eye movements is characterized by impairment of the lateral gaze movement while the convergence movement of the eyes is preserved. The types of lateral gaze movement are:

1. Command movement, movement on a command, such as: "Look to the right!" This is also known as schematic movement.

2. Optically elicited movement; that is, movement toward a seen object. This is also known as follow movement.

3. Compensatory eye movement on head rotation due to a labyrinth reaction. This is also known as vestibular movement.

Horizontal gaze palsy may involve the lateral rectus of one eye and the medial rectus of the other eye to the same degree. This is known as the congruous form of gaze palsy. The incongruous form of gaze palsy may affect one of the two muscles to a different degree or the medial rectus alone.

Dr. Kestenbaum then cited a series of his own cases and cases taken from the literature which illustrated the following types of congruous gaze palsy.

1. General palsy of lateral gaze in which all main types of movement are abolished.

2. Bielschowsky type of gaze palsy in which labyrinthine countermovement is preserved, while the other types of movement are abolished.

3. Oppenheim's type of gaze palsy in which vestibular movement and follow movement are preserved and schematic movement is abolished.

4. Isolated lesion of schematic movement in which vestibular movement and follow movement are preserved, only schematic movement being abolished.

In these types of congruous gaze palsy,

the medial rectus of the one eye and the lateral rectus of the other eye are involved to the same degree, and the convergence movement is normal.

Incongruous gaze palsy was observed in the following forms:

1. Foville's syndrome. The right eye cannot be adducted in lateral gaze but it can be adducted on a convergence impulse; the left eye cannot be abducted and shows paralytic squint. This proves that in addition to the lesion of the posterior longitudinal bundle, along which run the lateral gaze impulses, the abducens nucleus or abducens nerve is involved.

2. Intranuclear gaze palsy. Adduction of the right eye is more disturbed than abduction of the left eye; convergence is normal. The lesion is usually considered to be in the left posterior longitudinal bundle between the level of the sixth-nerve nucleus and that of the third-nerve nucleus, but close to the former one.

3. Supranuclear medialis paralysis or superior intranuclear gaze palsy. Adduction of the right eye in attempted lateral gaze is abolished. But in attempted convergence, normal abduction of the left eye is normal. This lesion is also localized in the left posterior longitudinal bundle, but higher up than in the previous form.

In a case of supranuclear medialis palsy, a paradoxical phenomenon was seen. In binocular vision, the left eye could not look at any object on the right side, but when the right eye was closed, the left eye could turn toward the object. This movement was achieved by a convergence impulse, because the covered right eye was found to stand in adduction and the pupils were narrowed. Hence there was a substitution of a convergence movement for a lateral movement. Of course, this could be shown only when the right eye was covered so that no diplopia occurred.

4. Bilateral intranuclear gaze palsy. In this case both medial recti do not work in lateral gaze but do in convergence. This syndrome is significant for a median lesion involving both posterior longitudinal bundles between the third-nerve nucleus and the sixth-nerve nucleus.

Dr. Kestenbaum summed up by saying that all these forms of incongruous gaze palsy involve all the main forms of gaze movements to the same degree.

Bernard Kronenberg,
Recording Secretary.

OPHTHALMOLOGICAL SOCIETY OF MADRID

March 12, 1948

Hysterical blindness

Dr. Marin Amat and Dr. Marin Enciso discussed a recent case which showed the importance of careful and conservative diagnosis and treatment in this condition. A young woman, aged 23 years, suffered complete loss of vision in both eyes after a quarrel with her fiancé. The eyes and adnexa appeared to be completely normal.

As her vision began to return, it was possible to map the very reduced central visual field, the inversion of the red and blue fields, the classical field curves of Foerster, fatigue curves of Vilbrand, and so forth.

Psychiatric treatment together with vitamin therapy restored her vision and general equilibrium.

Discussion. Dr. D. Sinforiano Garcia Mansilla said that the case was interesting since it began as an amaurosis and then developed into amblyopia, permitting visual field tests for white and colors.

Many years ago he had published a case of hysterical blindness in a man who presented the following history. He was a student of timid nature who, in the evening before taking a final examination at the academy, suddenly became completely blind.

Eye examination, in which three colleagues assisted, established the presence of complete blindness, the absence of any lesion, and the retention of pupillary motility. These three symptoms pointed to hysterical blindness.

Previous nervous manifestations of the patient were that during the previous year, while explaining an equation on the blackboard at an examination, his vision suddenly became bad, the blackboard appearing red and the chalk green, and he had had to ask the proctor to permit him to rest. After a little rest, he recovered, saw the blackboard and chalk in their natural colors, and proceeded with the examination.

This history made the diagnosis plain. The patient was given a placebo and suggestive treatment. One week later, after a quiet sleep, his sight returned completely.

This is a typical case of hysterical amaurosis with the classical triad of symptoms: sudden blindness, normal fundus, and persistence of pupillary reaction. To these three may be added a fourth symptom—sudden and total recovery.

Dr. Munoz Pato: Given the psychic disturbances that characterize hysteria, one should be prudent both in diagnosis and treatment. Although mild cases can be quickly cured in one session (by instillation of drops, utilization of some complicated instruments, and so forth), other cases are more complex and serious. In these, simple methods will fail and the longer procedure of Dr. Marin Amat and Dr. Marin Enciso must be resorted to.

Dr. Marin Amat said that he does not use the word "hysteria" with either men or women but prefers the term proposed by Babinski, "pithiatism," which implies that the condition is curable by persuasion.

To be sure, the triad of symptoms, sudden blindness, normal fundus, and retention of pupillary reflexes, indicate hysterical amaurosis. There are some conditions, however, that exhibit these symptoms and are not of hysterical nature. Such a one, for example, is uremic amaurosis from lead poisoning. In this instance, the changes are in the visual cortex. The optic fibers that pass to the anterior colliculus and from there to the nucleus of the third nerve and that subserve the pupillary reflexes are not affected. According to Charcot, we find in hysteria a narrowing of the field of consciousness, a narrowing of the field of vision, and an unfolding of the personality.

Dr. Martin Amat agreed with Dr. Munoz Pato that there are always certain phases of a neurosis in hysterical amaurosis. Application of psychiatry should, however, be reserved for special cases. In the ordinary cases, the ophthalmologist should have enough general and psychiatric knowledge to treat the condition.

Erb-Goldflam disease

Dr. Bartolozzi presented two patients, a mother and daughter, with the typical picture of pseudoparalytic myasthenia or Erb-Goldflam disease. The girl showed marked bilateral ptosis and almost total paralysis of the extrinsic musculature of both eyes, with perfect preservation of the power of the intrinsic eye muscles.

The mother showed pseudoparalysis of the muscles of the lips, tongue, and larynx. Electrical exploration disclosed the nuclear origin of both processes. The myasthenic reaction was negative, but the clinical picture, the improvement of the condition by rest, its aggravation during the day, as well as the amount of creatine in the urine, all testified that it was a case of myasthenia, although different clinical pictures were present in mother and daughter.

Nevus pigmentosus in a pyterygium

Dr. Marin Amat and Dr. Marin Enciso demonstrated the case of a 48-year-old peasant who for 30 years had had a little black spot on the conjunctiva of the left eye near the sclerocorneal margin at about the 9:30-o'clock position.

This spot did not give him any trouble but when he developed a pterygium in this eye several years ago, the spot seemed to increase in size. The pigment spot was removed during the operation on the pterygium. The laboratory diagnosed it as nevus pigmentosus.

Joseph I. Pascal,
Translator.

AMERICAN JOURNAL OF OPHTHALMOLOGY

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INTERNATIONAL CONGRESSES

For the physician tourist an international congress combines the stimulation and recreational delights of travel with the deepened sense of fellowship between professional colleagues. There are the teachers and thinkers whom we have perhaps known only through the printed page or by the medium of casual correspondence. Sometimes, it is true, these may disappoint us and take on less significant stature, physically or intellectually, than they had carried in our imaginations before the personal encounter. On the other hand we now and then enjoy the pleasurable stimulus of becoming acquainted with brilliant personalities never revealed to us through medical journals; for there are many such among our great profession in general and our specialty in particular. It is unfortunate that some of the friendships thus created suffer too easily the attrition due to time and space.

The First International Congress of Ophthalmology, held in Brussels in 1857, must have displayed the wonderful freshness of knowledge, discovery, and enthusiasm associated with a decade of study in the revelations of ophthalmoscopy. At that time

this technique of examination was still sufficiently youthful to have acknowledged a period during which the master Graefe had regarded glaucomatous excavation as a protrusion of the optic disc (an impression which he soon revised). There followed the Paris Congress of 1862, the first Amsterdam Congress of 1867, London in 1872, New York in 1876 (Herman Knapp as a shining light), Milan in 1880, Heidelberg in 1888, Edinburgh 1894, then Utrecht (Holland) 1899, Lucerne 1904, Naples 1909.

War of course interfered with the regular succession and sometimes with place of meeting. There had been the Franco-Prussian conflict. World War I clashed with the arrangements for the twelfth Congress, planned for St. Petersburg (now Leningrad) in 1914. The very successful second Amsterdam Congress fell about midway between World Wars I and II, in 1929. The fourteenth Congress, in Madrid, 1933, was a few years ahead of the Franco revolt in Spain. The Cairo Congress of 1937 was held while Spain was still in the throes of fratricidal warfare.

Very successful gatherings occurred respectively in Washington in 1922 and in London in 1925. The former could not be completely international in its scope, because officially the United States was not yet at peace with Germany and Austria. It is not, however, accurate to state (as was done quite recently) that the Washington Congress was limited to English-speaking ophthalmologists. German could not be recognized, but the official languages of the Congress were English, French, and Spanish, and papers were read in all three. The Congress at London in 1925 was definitely a Congress of English-speaking ophthalmologists, and was very well attended.

After a good deal of discussion between the official representatives of different countries, it appears now that the sixteenth International Congress of Ophthalmology will be held in London, England, July 17 to 21, 1950. Apart from any startling complications in the international political situation, that Congress is likely to be attended by a large number of colleagues from the United States, and the making of necessary reservations will soon be proper matter for consideration.

During World War II, the impossibility of holding such Congresses in Europe led an energetic group of American ophthalmologists, north and south of the Equator, to plan for the organization of a Pan-American Congress of Ophthalmology. As a beginning, this was held after the conclusion of the meeting of the American Academy of Ophthalmology and Otolaryngology at Cleveland in 1940, the languages officially used in the program being Spanish, Portuguese, and English.

A second Pan-American Congress of Ophthalmology was planned for November, 1943, in Montevideo, Uruguay, but the travel difficulties arising from the War caused repeated postponements of this gathering, which was finally held in November, 1945. A third Pan-American Congress was very successfully staged in Havana in January, 1948, with a large attendance by ophthalmologists (and their families) from North, South, and Central America. The next, fourth, Pan-American Congress will be held in Mexico City in 1952.

Undoubtedly, under peaceful conditions, many ophthalmologists of the United States will attend both the London International Congress in 1950 and the Mexico Pan-American Congress in 1952, and both events should be kept in mind in making travel plans for the coming four years.

W. H. Crisp.

BASIC SCIENCE RESEARCH IN OPHTHALMOLOGY

One of the encouraging features of postwar ophthalmology in the United States is the number and quality of basic science studies dealing with eye problems that have

been reported. A substantial proportion of these studies has been made by ophthalmologists but more have been made by nonophthalmologists working in university eye departments or institutes or in the basic science departments of the medical schools and universities.

The Association for Research in Ophthalmology, which is the only national ophthalmological society dealing primarily with experimental ophthalmology and offering membership on an equal basis to both ophthalmologists and nonophthalmological basic science workers, has recognized the importance of providing a common meeting ground for the ophthalmologist and the nonclinical investigator. At the 1948 meeting of the association, its constitution was amended to permit the formation of regional sections similar to those established by such other organizations as the Society of American Bacteriologists. Section secretaries have already been named and two sections—the Western Section whose secretary is Dr. Michael J. Hogan of San Francisco; the Eastern Section whose secretary is Dr. Alson E. Braley of New York—have already held section meetings.

The Western Section meeting was held on March 27, 1948, in San Francisco and was attended by about 75 ophthalmologists and nonophthalmological investigators from the various basic science departments of the western universities. The program included the presentation of five experimental studies, followed by a banquet and an address by Frank W. Weymouth, Ph.D., professor of physiology at Stanford University, entitled, "Recent measurements of the living eye and their relation to the development of myopia." A second meeting is to be held in San Francisco this month, immediately following the examinations of the American Board of Ophthalmology.

The first meeting of the Eastern Section was held in New York City on November 13, 1948. Four papers were presented, one by an ophthalmologist and the other three by basic science workers from Harvard University and Columbia University. About 100 persons attended the meeting.

The section meetings, as judged from these first two, will not be in competition with the annual meeting of the national association but on the contrary will, in the main, provide a forum for the presentation of preliminary reports, the more important of which may subsequently be developed for presentation at the national meeting. Perhaps the most important function of the sections will be to bring together on a regional basis all the clinical and nonclinical investigators interested in ophthalmic research. In this age of coöperative research it is only by a constant interchange of ideas, facilitated by personal contacts between workers, that we can hope to see the full development of basic science investigation.

Phillips Thygeson.

THE FOURTH ARGENTINE CONGRESS OF OPHTHALMOLOGY

The Argentine Congress of Ophthalmology, which is held every four years, had its fourth assembly December 13 through 18, 1948, at Mar Del Plata, Argentina. The officers this year were: President, Dr. Diego M. Argüello; vice-president, Dr. Roberto F. Pereira; secretary, Dr. Juan L. Giambruni; treasurer, Dr. Bruno Tosi.

Mar Del Plata, Argentina's most famous and fashionable summer resort, is located on the coast 250 miles south of Buenos Aires. The meeting was held in the modern, air-conditioned auditorium of the Casino, or Kursaal, and most of those attending the congress lived at the beautiful Hermitage Hotel just across the street from the Casino.

The entire week was devoted to the meeting. On Monday morning the formal inaugural ceremonies were held at which time a cordial welcome was extended by the president of the congress, by federal and municipal officers, and by the titular professors of ophthalmology at the various uni-

versities. Greetings were received from the official visitors. A scientific session was held each morning from 9 to 12 o'clock, and this was followed by a 4-hour interlude for lunch, siesta, and recreation. The afternoon sessions began at 4 o'clock and lasted until 7; the evenings were free for social gatherings.

The scientific program was arranged along the lines usually employed in Europe. Certain subjects were selected for discussion, and this congress was devoted primarily to "Tumors of the eye and adnexa." Two other official themes were "Surgery of the extraocular muscles" and "Prevention of blindness." In addition to these subjects there were miscellaneous papers and moving pictures on aspects running almost the entire gamut of ophthalmology. Fourteen instruction courses were given. These were excellently arranged and presented and were most enthusiastically received.

In the spacious anterooms adjoining the auditorium there were scientific and commercial exhibits. The scientific exhibits were particularly meritorious. These were sponsored by the various universities instead of by individuals. There were exhibits from the Universities of Buenos Aires, La Plata, Cordoba, and Litoral. In addition, the government agencies, such as the Secretary of Public Health and the Secretary of Education, had comprehensive exhibits demonstrating the efforts they are making along lines related to ophthalmology and projecting their plans for the future.

There were the usual commercial exhibits, not only of Argentine firms, but also those of various foreign nations. Of particular interest was the wide variety of publications on display: the latest ophthalmological books of English, French, Swiss, German, Italian, and American authors were exhibited. Argentine manufacturers had on display their own model of a slitlamp, ophthalmometer, refractometer, ophthalmoscope, and so forth, as well as various surgical instruments.

The meeting had a strong international flavor due to the presence of many foreigners, including leading ophthalmologists of Europe and the other South American countries. Eminent visitors from Europe were Franceschetti of Switzerland, Arruga of Spain, Barraquer of Spain, and Velter of France. Alvaro was the official delegate from Brazil and the United States. Castroviejo and Hanson from the United States attended and participated in the program.

Argentine ophthalmologists are very versatile. In their number they include an international playwright, Dr. Carlos S. Damel, and an olympic fencer, Dr. Jorge Balza. They are all surprisingly good linguists. Most of them speak English, but all seem to have a knowledge of at least one language other than Spanish. They are amazingly indulgent of a foreigner's efforts to speak their language.

It was early summer in the Argentine, when the Congress was held, and the weather lent itself to recreation and social activities which were a delightful feature of the meeting. The beach was readily accessible to the hotel and, in addition, golf and other sports were available. The Casino, a tremendous recreational center operated by the government, has the largest gambling facilities in the world.

The impromptu gatherings for lunch and dinner were diverting and stimulating. Since on Wednesday afternoon there was no scientific session, a barbecue was held at a large private estancia in the pampas. After lunch some Argentine cowboys, or gauchos, demonstrated their horsemanship. Later in the afternoon a visit was made to another ranch where race horses and polo ponies are bred. A number of former Derby winners were exhibited.

The congress was concluded on Saturday evening by a most delightful banquet at which there were after-dinner speeches by the representatives of the various countries.

To me it was a great privilege and pleasure to attend this meeting. The scientific program was excellent; the subjects for dis-

cussion were many and varied; the presentations were well done; discussions were spirited but always tolerant. The Argentine people are extremely hospitable and friendly, and have the happy faculty of combining their serious scientific endeavors with the light touch of pleasure and conviviality.

I departed with a great affection for the Argentine ophthalmologists and a great respect for their ophthalmology.

Algernon B. Reese.

BOOK REVIEWS

DETAILED ATLAS OF THE HEAD AND NECK. By R. C. Truex and C. E. Kellner. New York, Oxford University Press, 1948. 135 pages, 136 colored plates, index. Price, $15.00.

We have waited a long time for an atlas like this. It vividly recalls the famous anatomic atlas of Johannes Sabotta and J. Playfair McMurrich, long out of print and a collector's item. Dr. Truex, associate professor of anatomy, and Mr. Kellner, artist, Department of Anatomy, College of Physicians and Surgeons, Columbia University, have worked, in the words of Professor Detwiler in his foreword, "diligently and untiringly on this atlas, and in a state of true symbiosis!"

The beauty of the plates and the concise, accurate descriptions that accompany them cannot be improved upon. Figures 1 to 82 detail the regional anatomy; Figures 83 to 104, the skeletal structures; Figures 105-116 are representations of frontal sections; and Figures 117 to 136 are those of transverse sections.

The anatomy of the globe, the orbit, and the adjacent structures are clearly displayed, better perhaps than if the actual injected specimens were in a tray in front of you. Those who are sensitive to formaldehyde had better take care, for the pictures are so true that an allergic response could result, if our friends the psychosomatic experts are correct.

The publishers deserve enormous credit for their splendid job. Not a single ophthalmologist should be without his own private copy.

Derrick Vail.

THE W. H. ROSS FOUNDATION (SCOTLAND) FOR THE STUDY OF THE PREVENTION OF BLINDNESS. Reprinted Papers. London, University of London Press, Ltd., 1948. Paper binding, 232 pages, appendix with statistical tables. Price, 3 shillings.

The Ross Foundation is an organization of the broadest scope with a full-time research ophthalmologist as director. The present volume contains the history of this great undertaking and a report on the research sponsored to date. All the technical papers have been published in various professional journals as selected by the individual investigator. The AMERICAN JOURNAL OF OPHTHALMOLOGY was the choice for the significant paper on ocular siderosis by Loewenstein and Foster.

William Henry Ross, a self-made man of great wealth, established the Foundation in 1935 after becoming sightless. He lived until 1944 and was impressed by the continuous achievements of his philanthropy. The Foundation popularized sodium sulfacetamide, first for counteracting infections of the eye following mustard gas, next for the better control of corneal ulcers. The treatment recommended was direct application of the powder to the ulcer followed by afterinstillations of sulfacetamide solution. The sulfacetamide penetrated readily into the cornea, much more than sodium sulfadiazene, did not produce deleterious irritation, and its local use resulted in a much greater concentration in the ocular tissues than was attainable by systemic sulfonamide therapy. The intravitreal injection of pure penicillin was found highly effective in preventing panophthalmitis experimentally. The drug diffuses so slowly from the vitreous that an adequate concentration is maintained for 2 to 3 days.

The industrial studies showed that fluorescent lighting lost 50 percent of its effectiveness in 18-months' time. In the schools a careful comparison of reading age with mental age revealed dyslexia in some degree in 11.5 percent of boys and 7.4 percent of girls. The Foundation is now assembling records of blindness in one eye for their great value in the study of prevention. Cannot a similar survey be made in this country?

James E. Lebensohn.

ESSENTIALS OF PATHOLOGY. By L. W. Smith and E. S. Gault, with a foreword by the late James Ewing. Philadelphia, The Blakiston Company, 1948, Edition 3. 764 pages, 740 illustrations, a number in color; bibliography, index. Price, $12.00.

The busy ophthalmologist, immersed in the minute aspects of his field of activity, is in constant danger of forgetting that he is primarily a physician. There are times when he longs for the opportunity to renew his student days and to recall his absorption in the basic studies of medicine. Alas, not many of us have the time or energy to read textbooks of general medical subjects, along with our specialized reading.

One of America's great ophthalmologists of an older vintage, when catch-as-catch-can training was all that was available, had for his personal program of self-instruction a schedule of reading every night for five nights a week, divided into three one-hour periods. The first was given to ophthalmology, the second to general medicine, and the third to the world's great English literature. He faithfully pursued this schedule throughout his happy life. He was an educated man.

Ophthalmologists who wish to recapture their medical soul will take pleasure in owning and reading Smith and Gault's well-known *Essentials of Pathology*, particularly in this beautiful new and completely revised edition. They will find, on nearly every page, information that is pertinent to ophthalmology and of use to them in their daily work.

For example, to pick some chapters at random, there is a splendid discussion of retrograde processes, another on disturbances of circulation, an excellent description of the avitaminoses, another of inflammation, and, particularly important in these days of a wide-open world, new information on animal parasites. These authors have taken great pains to illustrate their text liberally and most satisfactorily.

Apparently every system of the body is well covered, except the eye. This is deplorable, because general physicians and pathologists are entirely ignorant of ocular pathology. A chapter on this subject would complete a fine piece of work.

Derrick Vail.

TRANSACTIONS OF THE OPHTHALMOLOGICAL SOCIETY OF PARIS (and of the Ophthalmological Societies of the East, of Lyon, and of the West). Meeting of March, 1948, pp. 83-102.

Deschamps presents a man, aged 58 years, with all the signs and symptoms of an orbital neoplasm. Exact diagnosis of a mucocele of the frontal sinus was made only after orbitotomy. Recovery was uneventful, motility improved slowly, and the exophthalmos disappeared. Vision was restored. There was only a mild disturbance in the function of the superior oblique muscle. The disc remained pale with some blurring of its margin.

In a study of corneal nerves, Offret found that the staining methods of Cajal were unsatisfactory but that modification of Ranvier's technique was effective. Flat sections and radial incisions gave good exposure. A few Schwann's elements were easily seen.

Guillaumat and Lemaitre observed myopia gravis, retinitis pigmentosa, and congenital luxation of the lenses in a young woman whose parents were first cousins. The patient's general health was good. She

had four normal children, but each pregnancy had caused an increased loss of vision. Although the authors believe that the disease is essentially hereditary, they also suspect that the influence of hormonal factors may have caused the visual impairment after each delivery.

Sédan and Sédan-Bauby discuss micropuncture as a means of testing the resistance of the lens capsule. They comment on the older experiments of Czillag which had only recently become known to them. The authors, themselves, use a needle puncture of the lens capsule in vivo.

Larmande describes calcified and ossified angiomas of the choroid. Choroidal angiomatosis can cause calcium precipitation in the vessel walls of the lesion and its immediate neighborhood, even in the retina. These pathologic processes might be seen combined in a symptom complex which the author calls encephalofacial neurangiomatosis.

Hartmann describes an atypical case of suprasellar meningioma with unilateral dilatation of the optic canal. A woman, aged 49 years, had temporal hemianopia in the right eye with temporal pallor of the disc. The left eye was normal. Exact diagnosis was made only during surgery.

Alice R. Deutsch.

SOME ASPECTS OF OCULO-REFRACTIVE TECHNIQUE. By Malcolm Cholerton. London, Hammond, Hammond, & Co., Ltd., 1948. Clothbound, 147 pages, 23 figures, index and bibliography. Price, 21 shillings.

The author, a British ophthalmic optician (equivalent to the American optometrist), is concerned with the professional preparation of his colleagues, and this book aims to broaden their acquaintance with visual functions. His very readable digest is based on the works of Duke-Elder, Parsons, Traquair, Chavasse, and Luckiesh, supplemented by selected articles from the journals of ophthalmology, all of which are duly credited. Mr. Cholerton, who worked in the war with British and American ophthalmologists, maintains throughout a correct professional attitude. Scorning practitioners who prescribe base-in prisms for migraine, he states, "In view of the incidence, not infrequently, of migraine associated with pathological disturbances such as cerebral aneurysm or tumor, the patient should be referred for ophthalmological and neurological investigation."

His discussion on dynamic retinoscopy opens with this opinion: "In its present state of development as a technique it is based upon certain assumptions, the validity of which are still questionable." As regards tinted lenses, "The aim should be to remove or diminish the patient's conviction that a tint must be incorporated as a necessary part for the solution of his ocular disability."

The optical data submitted is at times insufficiently explicit. He suggests the use of a trial-case telescope, made by placing plus 20D. and minus 20D. lenses in the front and back cells respectively, but does not mention that this combination only functions at a distance of 10 inches. This slim volume no doubt will be of value to the group for whom it was written.

James E. Lebensohn.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

1

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

v. Bahr, Gunnar. **Measurements of the thickness of the cornea.** Acta ophth. **26**: 247-266, 1948.

The literature on this subject is reviewed and a new instrument for this purpose used in conjunction with the Gullstrand slitlamp is described in detail. The mathematical formula used to calculate the corneal thickness is explained. Normal eyes of 125 persons of both sexes and different ages were examined. The effect of hypertonic and hypotonic solutions on the corneal thickness was tested on rabbit and human eyes. The average thickness of the cornea is 0.565 mm. and varies between 0.46 and 0.67 mm. The cornea in eyes with myopia over four diopters was thinner. Changes in the corneal thickness of rabbits were produced experimentally by baths in solutions of unphysiological osmotic pressure. The thickness is increased by baths of 0.5-percent sodium chloride, and decreased by baths of a 2-percent solution.

Ray K. Daily.

Fornes Peris, Enrique. **The comparative morphology of the corneal fibrocytes.** Arch. Soc. oftal. hispano-am. **8**:821-826, Aug., 1948.

This is a detailed report on an investigation of the cornea of man, the rabbit, pig, bull, chicken, lamb, frog, cat, snake, and mullet with the Llombart silver stain method. All the corneal cells are fibrocytes. No histiocytes or leucocytes were encountered. Fibrocytes are irregular elements which under normal conditions are fixed or but slightly movable. They have an abundant cytoplasm which adapts itself to the form of the cell, and flattened anastomizing prolongations. The cells have two predominant forms, membranous as in man, and corpuscular as in the chicken. The cellular elements are abundant in all the corneas investigated; they have numerous prolongations, short in some cells, thin in others, and some cells have both types. The union of these processes forms a true syncitium, best demonstrated in the cornea of man and the hog.

The characteristic form and volume of the cell, the position of its expansions,

the manner of the anastomosis of the fibrocytes varies in different animals. The distribution of the cells in the connective tissue is quite regular in the chicken and complicated in man. The cellular expansions may be filiform, or may originate in a broad base and become narrow at the end; some are smooth and uniform in size throughout their entire extent, while others are bristly with spines, and irregular in size. The cornea of the hog is very similar to that of man and that of the cat less so. The fibrocytes of the hog, and to a lesser extent those of the cat, are similar to those of man in their unequal distribution, in the broad form of their extensions, and in the arrangement in broad layers. Ray K. Daily.

Meves, H. **The structure of the retinal arteries.** Arch. f. Ophth. **148**:459-467, 1948.

The tissues of 16 eyes of young persons were embedded in paraffine and stained with Weigert's elastica lithium carmine. Whereas the central artery near the lamina cribrosa shows a single layered internal elastic membrane just beneath the intima, the retinal branches present at least 3 or 4 elastic membranes. The membranes are concentrically arranged and interrupted by numbers of smooth muscle cells. The difference between the retinal arteries and the choroidal vessels of the muscular type is emphasized.

Ernst Schmerl.

Scobee, R. G. **The fascia of the orbit. Its anatomy and clinical significance.** Am. J. Ophth. **31**:1539-1552, Dec., 1948. (9 figures, 15 references.)

2

GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Fischer, F. P. **The frequency curves of senile ocular changes.** Ophthalmologica **116**:6-9, July, 1948.

In 1941 (Ophthalmologica 106:226) the author reported on the incidence in the various age groups of typical senile changes in man, such as arcus senilis, depigmentation of the iris and acquired cataract. The frequency distribution of these three characteristics of senescence was expressed by S-shaped (Sigmoid) curves (plotting incidence on the ordinate and age on the abscissa). The relationship between the logarithm of the frequency to the logarithm of age was expressed by a straight line except for the extremely high values. In the paper under review Fischer stresses the mathematical difference between growth curves and senescence curves (see the author's contribution on "senescence of the eye in Sorsby's Modern Trends in Ophthalmology, Vol. 2). Peter C. Kronfeld.

Joy, H. H. **Uveopigmentary sensitization.** Am. J. Ophth. **31**:1581-1588, Dec., 1948. (54 references.)

Knecht, F. **The influence of climatic conditions upon the non-acute glaucomas.** Ophthalmologica **116**:21-37, July, 1948.

This study was made in the department of ophthalmology of the University of Basle (Switzerland) which is suitably located for investigations of the influence of meteorological factors upon the development and course of diseases. In that locality A. Brueckner demonstrated a relationship between the weather and the onset of acute glaucomas. (See Archives of Ophthalmology 20:950, 1938.)

In the paper under review the non-acute glaucomas were classified as simple, chronic (characterized by recurrent mild attacks), secondary, absolute or hemorrhagic forms. More cases of non-acute glaucoma registered as new patients during the winter than during the summer of the years from 1936 to 1945. January and March represented the

maxima and August the minimum of the seasonal distribution curve. Close observation of the diurnal variations of ocular tension revealed a surprisingly high incidence of elevations that could be correlated with cold waves, heat waves or other sudden meteorologic disturbances.

Peter C. Kronfeld.

Rapisarda, Dante. **Conjunctival tuberculous hetero-allergy. Part II: histologic study.** Ann. di ottal. e clin. ocul. **73**:344-371, June, 1947.

Part I of this study was reported during the 36th Congress of the Italian Ophthalmological Society. Rabbits and guinea pigs were sensitized by injections of vaccines and of live bacilli of low virulence, and subsequently tests were made to determine the reactivity of the conjunctiva to instillation and subconjunctival injection of tuberculin and nonspecific stimuli (milk and gonococcus vaccine). In all cases the conjunctival reaction was more marked in the sensitized animals than in the controls, and nonspecific stimuli incapable of producing any reaction in normal animals produced intense and lasting reactions in the sensitized animals. This augmented reactivity (hetero-allergy) of tuberculin-sensitized animals to nonspecific stimuli may give a clue to the treatment of certain recurrent and intractable forms of conjunctivitis, and Rapisarda is carrying on further studies. The reactive process was studied histologically in its several phases. Three stages were distinguished, an exudative, a granulomatous, and a sclerotic. (8 figures, references.)

Harry K. Messenger.

Redi, Francesco. **Localized amyloidosis, with particular attention to conjunctival amyloidosis, in the picture of paraamyloidosis and their etiologic relationships.** Giorn. ital. di oftal. **1**:227-264, May-June, 1948.

Paramyloidosis, in its localized and circumscribed form, must be considered separately from amyloidosis, differentiated by the history, histologic aspects, and finally by the microchemical reaction. The differentiation is illustrated by a case of paramyloidosis of the myocardium, and one case of paramyloidosis of the conjunctiva. Experimental amyloidosis in the white mouse has all the characteristics of human generalized amyloidosis and not of paramyloidosis. In the course of chronic cavitating tuberculosis degenerative histologic changes are not found in the lids or conjunctiva nor are the infiltrative changes usually thought to be preamyloidosis changes. In the course of trachoma one does not find amyloid changes of the lids or even of the conjunctiva. Mechanical stimuli repeated many times have not given rise to degenerative substances in normal animals nor in animals treated with sodium caseinate. Trementine injected into the area of the lids of guinea pigs causes the amyloid substance to disappear in normal animals and in those treated with sodium caseinate. The experiments indicated that disturbances in metabolism have not influenced the pathogenic mechanism of localized amyloidosis, rather that local conditions are responsible factors.

Francis P. Guida.

Spyratos, S. P. **Promelanine.** Ann. d'ocul. **181**:556-565, Sept., 1948.

This nucleoprotein is an inductor for undifferentiated embryonic cells. In the secondary optic vesicle promelanine aids in the formation and differentiation of retinal and choroidal pigmentation. It transforms some cells of the periocular mesenchyme into melanoblasts. Melanophores of the eye and skin are apparently related. After birth, under some environmental conditions largely unknown, promelanine granules may transmit the tendency to specific types of inflamma-

tory reactions to other mesoblastic tissues. Sympathetic ophthalmia is thought to be a reaction of this type which involves primarily mesoblastic pigmentation in the uvea of both eyes. Chas. A. Bahn.

3

VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Albright, A. A., and Seretan, E. L. **Sulfathiazole sensitivity: with a review of the literature.** Am. J. Ophth. **31**:1603-1606, Dec., 1948. (18 references.)

Bárány, E. H. **The influence of gum arabic and dextran on the blood-aqueous barrier and intraocular pressure.** Ophthalmologica **116**:65-79, Aug. 1948.

Dieter and Duke-Elder reported marked lowering of the ocular tension after intravenous injections of concentrated solutions of gum arabic into rabbits. Both authors interpreted these lowerings as manifestations of the great influence of the colloid-osmotic pressure of the blood on the ocular tension. Closer analysis of these experiments reveals a striking absence of parallelism between the rise in the colloid-osmotic pressure of the blood on the one hand and the drop of ocular tension on the other hand. Bárány repeated these experiments with gum arabic solutions of varying concentration and confirmed the findings of Dieter and Duke-Elder. Following the injections he measured the ocular tension and, by means of the colloidometer of Roenne, the intensity of the aqueous flare. A striking parallelism between the colloid content of the aqueous and the drop in ocular tension became apparent. Both phenomena were also found to occur after the intravenous injection of gum arabic solutions of lower osmotic concentration than plasma. The same effects could be obtained with dilute solution of dextran which is a polysaccharide used in Sweden as a plasma substitute. In its natural form dextran has a molecular weight of many millions. By hydrolysis the molecule can be broken down to particles of a molecular weight of less than 200,000. The natural substance in dilute solution produced a drop in ocular tension with marked aqueous flare, while equivalent amounts of the hydrolysate were ineffective. These observations show that the hypotony after the intravenous injection of high-molecular colloids is not caused directly by osmotic factors. "When hypotony occurs it is always associated with colloid increase in the aqueous, signalling a breakdown of the blood-aqueous barrier. Injury to the barrier is probably a causal factor in the production of hypotony by these substances (gum arabic and dextran)."

Peter C. Kronfeld.

Boros, B., and Vönöczky, J. **Penetration of sulfonamides into the eye.** Ophthalmologica **116**:177-186, Sept., 1948.

The penetration into the eye of systematically applied sulfonamides was studied in cats. Topically applied pilocarpine, atropine or adrenaline did not significantly alter the rate of sulfonamide penetration. Gynergen and bacterial inflammation raised the intraocular sulfonamide concentration significantly. After single intravenous doses of 3 to 4 grams of sulfonamides adequate sulfonamide levels were found in the vitreous of a few human eyes which had to be enucleated because of endophthalmitis or absolute glaucoma. The ineffectiveness of sulfonamides in many types of intraocular infection should not be attributed to low intraocular sulfonamide levels.

Peter C. Kronfeld.

De Vincentiis, M. **The oxidation activity of the human cataract in the pres-**

ence of amino acids. Rassegna ital. d'ottal. 17:247-253, July-Aug., 1948.

The author studied the respiratory behavior of the cataractous human lens in the presence of amino acids. He established the fact that cystine, asparagine and tyrosine were increased and that glycocol, leucine and histidine were diminished in amount. He also observed a diminution of alanine and tryptophane. The changes established the fact that all respiratory activity of the lens disappears from the opaque lens fibers.

Eugene M. Blake.

Duke-Elder, S., and Davson, H. **The present position of the problem of the intra-ocular fluid and pressure.** Brit. J. Ophth. 32:555-569, Sept., 1948.

For many years it has been accepted as fact that the aqueous is an ultrafiltrate of the plasma, a dialysate which moves directly through the capillaries of the ciliary body into the anterior chamber by simple osmosis. If this were true this dialysate should be in dynamic equilibrium with the plasma. This theory fails to explain some of the data. The concentration of the electrolytes sodium and chloride in the aqueous is consistently higher than in the blood stream. It has been suggested that these substances were involved in metabolism of the lens, but since the same imbalance holds in the aphakic eye there must be some other explanation. The concentrations of carbohydrates in the aqueous of the normal and aphakic eye are much lower than in the blood and that complicates the problem further.

Nitrogenous substances, especially urea, are also present in lower concentration in the aqueous. Factors other than those of simple osmosis must be at work. As an alternative theory, the authors suggest that aqueous is actually elaborated entirely within the cells of the ciliary body and is drained away too quickly to be altered by osmosis with the plasma.

Morris Kaplan.

Ferguson, W. T. W. **Ocular disturbances associated with malnutrition.** Tr. Ophth. Soc. U. Kingdom 66:108-109, 1946.

The author reports on the ocular manifestations of volunteers whose diet was deprived of vitamin A in one experiment, and of vitamin C in another, conducted for the Medical Research Council in Sheffield. The two best criteria for assessing the course of the depletion of vitamin A were the vitamin A and carotenoid content of the blood plasma, and the capacity for dark adaptation.

There was a rapid drop in the carotenoid content of the blood in three months. The average value fell from an initial 150 i.u. per 100 ml. of plasma to 12 or 40. There was a distinct correlation between the vitamin A level in the blood plasma and the capacity for dark adaptation. The latter was normal if this level was about 50 i.u. per 100 ml. In only three subjects was this level reached after a period of 25 months. No changes were found in the degree of opacity in the conjunctiva that were not found also in the controls and a few small aneurysmal dilatations of the limbal vessels were also noted in the controls.

The depletion of the diet in vitamin C caused no change in the capacity for dark adaptation and no changes were visible with the corneal microscope.

Beulah Cushman.

Gandolfi, C. **The action of Priscol on the retinal arterial pressure.** Ann. di ottal. e clin. ocul. 73:336-343, June, 1947.

Priscol "Ciba" is 2-benzylimidazoline hydrochloride, a new peripherally acting vasodilator. Conjunctival instillation of Priscol in man had no effect on the

retinal arterial pressure as measured with Baillart's ophthalmodynamometer. The intramuscular injection of 1 cc. of a 1-percent solution caused only a slight and inconstant reduction, but a retrobulbar injection of the same quantity caused a rapid, definite, and prolonged reduction of the retinal arterial pressure. The injection did not affect the systemic blood pressure and made no significant alterations in the intraocular pressure.

Harry K. Messenger.

Gandolfi, C. **A new drug for surface anesthesia in ophthalmology.** Ann. di ottal. e clin. ocul. **73**:439-441, July, 1947.

A ½-percent solution of Butococaine, a butyn-like product of the Zambelletti laboratories, was found on clinical trial to meet all the requirements for satisfactory surface anesthesia. An instillation of a single drop produced in one minute complete corneal anesthesia which lasted ten minutes. There was no mydriasis or desquamation of the corneal epithelium, and the pupillary reactions and the ocular tension were not altered. No intolerance was noted in several hundred patients. Solutions may be sterilized by boiling. The slight hyperemia which follows the instillation may be prevented by the addition of epinephrine solution.

Harry K. Messenger.

Jones, I. H., Muckleston, H. S., Lewis, E. R., and Owens, G. R. **Nutrition in ophthalmology and otolaryngology.** Ann. West. Med. and Surg. **2**:491-499, Nov., 1948.

The authors emphasize the embryological view of nutrition in that the germ layers have specific vitamin requirements. Rats on controlled diets were perfused and the microscopic tissue studies are reported. In dietary deficiencies the cells were found to be shrunken, many absent. When the animals were given complete diets the tissues rapidly returned to normal.

Orwyn H. Ellis.

Kapuscinski, W. **On symptoms of the pulse in the central retinal artery.** Brit. J. Ophth. **32**:881-885, Dec., 1948.

Direct examination of the fundus shows two kinds of pulse, one spontaneous and the other artificial, from pressure on the eyeball. The author has observed that when pressure is made on the eyeball the first movement is a sagging of the walls of the artery which is synchronous with the cardiac systole. If the pressure on the eyeball is increased then the rhythm of the arterial pulse becomes alternate. There is then a dilatation in the retinal artery simultaneously with the cardiac systole, and a contraction of that artery with diastole. The latter is the phenomenon which should be interpreted according to Graefe's theory.

Orwyn H. Ellis.

Knape, Birgitta. **Studies on the effect of certain stimulants on the accommodation of the eye and of the threshold value for the effect of vitamin B_1 on the accommodation.** Acta ophth. **26**:35-40, 1948.

Accommodation was tested by the Vannas method for each eye separately immediately before the administration of the stimulant, directly after, and at intervals of varying length. The effect of the oral administration of pervitin was tested in 20 persons, of intramuscular injections of coramin in 6, of caffein in 10, and of intravenous injections of vitamin B_1 in 64. The charted data show that the maximum effect, a 5-percent increase in accommodation for pervitin, occurs after 1½ to 2 hours, and accommodation falls below the initial strength after 2½ hours. The maximum effect, a 5-percent increase in accommodation, occurs almost immediately after the injection of coramin, and there is no subsequent depres-

sion. The tests for vitamin B_1 were controlled with injections of physiologic saline solution, which had no effect on accommodation. The threshold value for the effect of vitamin B_1, to which accommodation appears to be very sensitive, is between 2 and 5 mg. Half an hour after the intravenous injection of 5 mg. of vitamin B_1 accommodation is increased 6.1 percent, and the effect lasts about 24 hours; the effect of smaller doses is less marked and of shorter duration.

Ray K. Daily.

Macaskill, J., and Weatherall, M. **Observations on experimental pneumococcal infection of the rabbit's cornea and on their treatment with penicillin.** Brit. J. Ophth. **32**:892-899, Dec., 1948.

The authors used a strain of pneumococcus that produced constant lesions when injected intracorneally. Subcutaneous administration of penicillin was found to be much less effective than the subconjunctival injection of 1,000 units per kg. body weight at 12-hour intervals which completely arrested these infections.

Orwyn H. Ellis.

Mann, Ida. **Tissue cultures of mouse lens epithelium.** Brit. J. Ophth. **32**:591-596, Sept., 1948.

Attempts to grow mouse lens epithelium in tissue culture are described. Lenses of embryo mice in late stages of development were used. No culture survived more than 12 days. If the capsule was left intact no changes in the tissue occurred. If the capsule was ruptured at the moment of planting the subcapsular epithelium proliferated and grew all around the capsule in a flat sheet of large, globular, clear cells. These cells did not survive beyond ten days. (8 figures.)

Morris Kaplan.

Neujean, G., Weyts, E., and Bacq, Z. M. **Action of B.A.L. on ophthalmologic accidents resulting from treatment with tryparsamide.** Bull. Acad. roy. de méd. de Belgique **13**:341-350, 1948.

Eye complications during treatment of trypanosomiasis with tryparsamide are frequent. Observations made on negroes at the Institure for Tropical Medicine at Léopoldville, in whom the trypanosomiasis had attacked the central nervous system and who had been treated with tryparsamide, showed the efficacy of B.A.L. in combating visual complications. This action, though never spectacular, is often, but not invariably, favorable, even when the trouble has been of long standing, and when no improvement can be seen ophthalmoscopically in the lesions of the optic nerve. B.A.L. hinders the therapeutic value of the tryparsamide. The authors demonstrate this action by means of a chemical equation. Nine detailed case histories are given. (6 references.)

B. T. Haessler.

Palm, Erik. **The phosphate exchange between the blood and the eye.** Acta ophth. Suppl. 32, pp. 1-114, 1948.

The objective of the present investigation was to follow the passage of the radioactive isotope of phosphorus, 32 P in its transit from the blood through the anterior uvea and aqueous to the lens; it was hoped that the findings might throw some light on some of the as yet unknown processes of the eye, such as the formation of aqueous and the metabolism of the lens. The use of an isotope of a substance which normally occurs in the body, in the study of vital processes, permits the making of investigations under undisturbed physiologic conditions; the data of former investigations are vitiated by the error in the results caused by an interference in these processes by the introduction of substances foreign to the organism, such as dyes, or by a disturbance in the osmotic balance through the use of abnormally high concentrations of substances nor-

mally occurring in the body. The chemistry of the phosphorus compounds that take part in the metabolism of the eye is reviewed, the experimental arrangement for the present investigation described in detail, and the results are tabulated and presented graphically. The experiments were done on living rabbits and on isolated lenses in vitro. Labeled phosphate in negligible amounts was injected intraperitoneally in rabbits, and its concentration in the blood determined at various intervals. At different times the animals were killed, their eyes extirpated, and the aqueous humor, vitreous body, anterior uvea, lens and cornea removed for chemical analysis, which revealed to what extent the phosphate in the various fractions had been replaced by the newly administered phosphate. The experiments on isolated lenses were performed by placing the lenses in a labeled phosphate bath the composition of which approximated that of aqueous. At different intervals the amount of this phosphate in the lens was determined by radioautographs. The radioactive substance darkens a photographic film and provides a rough picture of the distribution of the newly added phosphate in the lens. At the conclusion of the experiment the phosphate content was determined by trichloracetic acid extracts. The anterior and posterior lens surfaces were tested separately to determine the difference in the metabolism The data show that a short time after the intraperitoneal injection the newly introduced molecules are found inside the lens and are distributed along the path of transport to it. The slowest exchange takes place between the blood and the anterior uvea. Apparently there is a barrier to the permeability in that area. Determinations of the organic phosphate in the uvea reveal that approximately all phosphate passing through the uvea undergoes a transitory organic phase; this metabolism in the uvea lends support to the secretory theory of the formation of aqueous. The concentration of the labeled substance is almost the same in the uvea, the aqueous, and in parts of the organic and inorganic phosphate of the lens. The variations in the phosphate content of the anterior uvea and the aqueous follow one another closely, indicating a rapid exchange between the anterior uvea and the aqueous. The author suggests that this agreement indicates that the phosphate has a similar function in these tissues, perhaps as a carrier for a flow of carbohydrates from the blood to the lens. In the lens the newly introduced phosphate is rapidly converted into an organic form. Experiments on isolated lenses indicate that the metabolisms are different in the epithelium and in the substance of the lens. The material penetrates into the lens from the experimental bath through both the anterior and posterior surfaces with about equal intensity. An esterification of the labeled phosphate takes place at both surfaces, and the newly formed hydrolysable phosphate compounds appear in about the same proportion at both surfaces. The phosphate fraction remaining after hydrolysis for seven minutes is found only at the anterior surface of the lens. Since this fraction, which contains the first compounds of phosphorylation of carbohydrates, is found only at the anterior surface of the lens, it seems probable that such a process is associated with the epithelium of the lens, perhaps in connection with an absorptive activity.

Ray K. Daily.

Remler, O. **Examinations in blind people with regard to the 24 hour rhythm.** Klin. Monatsbl. f. Augenh. **113**: 116-137, 1948.

Th vegetative functions of the body which include temperature, ocular tension, metabolism, digestion, and the activities of the renal, the cardiovascular

and the central nervous system are subject to a 24-hour rhythm. Excretion of urine, for instance, normally has its peak in the morning, the temperature in the late afternoon. The author examined 75 blind persons, eight of whom had been blind since early childhood, in regard to the behavior of the rhythm of their vegetative functions. There was relative similarity in behavior of temperature curve, pulse, blood pressure and urine excretion. Whenever the temperature curve was normokymatic, the others were normokymatic, too. Whenever the temperature curve was inverse, the other functions usually behaved in an inverse manner. One half of the persons who became blind later in life, as well the eight who were blind early had a normal pattern of 24-hour rhythm. This group comprised mostly people who were psychologically of the cyclothymic type and were mentally well adjusted. The greater number of the other half exhibited an inverse type of rhythm. A few showed a dyskymatic curve without any special characteristic feature. Most of the men in this latter group were psychologically of the schizothymic type, which comprises the introverts, the neurotics and those living under tension. Remler points to the normal behavior of rhythm in those who became blind early as proof that the day and night change has no influence on the establishment of such rhythm, and that rhythm is of endogenous origin. He believes that the inverted rhythm in the schizothymic types is a reaction to the new sightless environment and is influenced by the mental attitude. (References.) Max Hirschfelder.

Røe, Oluf. **The ganglion cells of the retina in cases of methanol poisoning in human beings and experimental animals.** Acta ophth. **26**:169-182, 1948.

In a clinical study reported by the author in 1946, he showed that severe acidosis is necessary for the development of amblyopia and amaurosis. Experimental work on rats failed to find any acidosis in poisoned animals. He now reports the histologic examination of 12 eyes enucleated from patients who had died of methanol poisoning and of 21 rats and rabbits killed with methanol. The human retina shows severe degenerative changes in the ganglion cells. These changes did not develop in the experimental animals. A comparison of the clinical and experimental findings thus shows that there is a fundamental difference in the action of methanol on animals and human beings. Because of the failure to verify the significance of acidosis in animals, its importance to human beings was not recognized, and the failure to treat it resulted in unnecessary loss of life and sight. Ray K. Daily.

Sorsby, A., and Ungar, J. **Distribution of penicillin in the eye after injections of 1,000,000 units by the subconjunctival, retrobulbar and intramuscular routes.** Brit. J. Ophth. **32**:864-873, Dec., 1948.

The authors review the literature and point out that adequate intraocular therapeutic levels have been obtained with subconjunctival penicillin injections, and that higher levels can be obtained when adrenalin is used as a diluent. In the present experiments adequate therapeutic levels were obtained for 48 hours after one injection. The levels obtained with retrobulbar injection, although considerable, are distinctly lower than those obtained by subconjunctival, and the levels from intramuscular injection are lower still. Massive systemic doses showed adequate therapeutic levels intraocularly. Orwyn H. Ellis.

Vannini, A. **The influence of vitamin B_1 upon corneal anesthesia.** Rassegna ital. d'ottal. **17**:197-206, May-June, 1948.

Experiments were conducted upon human and rabbit eyes to determine whether vitamin B_1 has any influence upon the induction of anesthesia of the cornea. The vitamin was used in solution, the tonicity of which was less, greater than, or equal to that of the aqueous. No evidence of production of anesthesia could be determined. The use of cocaine upon one cornea and cocaine plus thiamine solution in the other eye resulted in lessened anesthesia from the latter. The same was true of novocaine and other local anesthetics. Experiments upon rabbits seemed to suggest that the vitamins aid in the process of regeneration of nerve fibers.

Eugene M. Blake.

4

PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Bailliart, P. **Reflections on the theories of vision.** Ann. d'ocul. **181**:514-534, Sept., 1948.

This contribution deals with a series of subjects which are suggested in a program for ophthalmic investigation. The first includes the specific photochemical and electrical reactions which transform light into sight, especially in the retina. Little is known of the details involved in the chemical composition or action of rhodopsin and its allied substances, the functions of the rods and cones, and the intercommunicating fibers of the retina. The relative differences in the perceptive powers of the nasal and temporal retina as well as their respective involvement in diseases such as glaucoma are also fruitful fields for investigation. The same is true of the shadows formed on the neuroepithelium by the retinal and choroidal vessels, and the complex subject of color vision. For those interested in ophthalmic problems this contribution has much of interest.

Chas. A. Bahn.

Beach, S. J. **Verified refraction.** J.A.M.A. **138**:952-954, Nov. 27, 1948.

A refraction routine is described in which several methods of testing are used so that the results of one verify those of another. It is as simple as is possible without a sacrifice of accuracy. The history and visual acuity are taken first. A pinhole disc is next used. A preliminary noncycloplegic retinoscopy is performed and with the lenses in place, the fogging method of noncycloplegic examination is done. The use of the astigmatic dials is discussed here. The cross cylinders are then used. The vision is then corrected binocularly by the use of "cyclodamia" in which both eyes are unfogged gradually and equally. (When binocular vision is 6/60 the eyes are fogged by approximately +1.50 diopters, when the vision is 6/12 by about +0.50, and when the +0.50 D-lens is removed the 6/6 line should be read.) The near point of accommodation is then measured. Cycloplegia should be used routinely in young persons with active accommodation. The postcycloplegic examination follows the precycloplegic routine. The author recommends that the ophthalmologists learn to use these methods of refraction.

H. C. Weinberg.

Berger, A., and Monjé, M. **The influence of aniseikonia upon depth-perception.** Arch. f. Ophth. **148**:515-528, 1948.

The authors place aniseikonic lenses in front of their eyes and study their own depth-perception with the help of the stereoeidometer. This instrument and its use have been described in a former article. When aniseikonic lenses were used which produced differences in size of the retinal images up to 17 percent, just a slight deterioration of the depth perception became noticeable. In another experiment adaptation to an artificially produced aniseikonia of 3.2 percent took place within an hour. Ernst Schmerl.

Bornschein, H. **The avoidance of line voltage variations in adaptometry.** Ophthalmologica **116**:187-191, Sept., 1948.

The author who is engaged in exact adaptometry states his experiences with automatic devices intended to compensate for the usual and practically unavoidable line voltage variations.

Peter C. Kronfeld.

Boshoff, F. H., and Jockl, E. **Errors of refraction and visual efficiency.** Acta Med. Orient. **6**:384-385, Dec., 1947.

Three cases of moderately high degree of myopia, one of them due to keratoconus are cited. All three patients were very proficient athletes, although they did not wear corrections for their refractive errors. One patient competed in the 1928 Olympic Games as a cricket player and was also an above average tennis player. The patient with the keratoconus was also an outstanding tennis player, and the third was an unusually good cricket player.

The authors believe the observations are worthy of record. They show that in the presence even of high degrees of uncorrected refractive errors precision performances, involving the handling of small fast-moving objects, can be carried out with a measure of efficiency exceeding that of fit healthy persons with normal refraction. Sharp definition of the retinal image can be only one of the factors which determine visual efficiency. The observations direct attention to the scope of effectiveness of the optical reception and interpretation fields in the brain and they demonstrate that athletic performances have a "total character," in which the visual functions involved become embedded in a comprehensive action pattern of the entire organism. Physical education can play an important part in ophthalmologic therapy, and the value of special eye exercises may be enhanced by the systematic use of sport and general training.

Donald T. Hughson.

Broendstrup, Poul. **The functional and anatomical differences between the nasal and temporal portions of the retina.** Acta ophth. **26**:351-362, 1948.

The difference between the nasal and temporal portions of the retina are reviewed and the author's own investigations to outline the anterior limits of the visual field by means of pressure phosphenes is reported. It was sought to determine whether the limits outlined by the phosphenes are identical with those charted perimetrically and campimetrically. The method consisted in making very slight pressure with a Bowman probe on the anesthetized eye. The pressure was made systematically, proceeding from the limbus backward in the horizontal, vertical, and two oblique meridians. The response to the pressure is a dark spot with a lighter center and a light halo. The distance between the limbus and the point of the most anteriorly possible phosphene was measured with a compass. Twelve persons, 8 of whom were emmetropic, were each examined twice. A visual phosphene field was constructed on the basis of the data thus obtained. Upward and downward the composite, constructed field practically coincides with the perimetrically measured visual field. Temporally, the field on the perimeter is more extensive, and on the nasal side the phosphene field. It is possible to release pressure phosphenes in a part of the peripheral field which is insensitive to light stimuli. Nasally the retina functions to the ora serrata; temporally, although the ora serrata lies 7 mm. behind the limbus the temporal phosphene boundary is 10 mm. behind the limbus, and the limit of light perception 12 mm. The determination of the anterior phosphene boundaries thus confirms the physio-

logical difference between the temporal and nasal parts of the retina. (2 figures.)

Ray K. Daily.

Cibis, P., and Mueller, H. **Studies in local adaptation with Maggiore's projection-perimeter.** Arch. f. Ophth. **148**:468-489, 1948.

According to Hering local adaptation is described in the following way. When a person continues to fixate a definite point, a colored stimulus in his peripheral field slowly looses its color and finally disappears completely. The time from the beginning of the stimulation to the disappearance of the colored impression is called the specific time of local adaptation, the time from the beginning up to the disappearance of any impression is called the general time of local adaptation. The authors use Maggiore's projection-perimeter and study the local adaptation of their own visual fields. The results are presented by curves similar to Wertheim's curves for peripheral visual acuity. The authors state that with weak stimuli and for a visual field of 15 degrees, points on different meridians but of the same distance from the retinal point of fixation are functionally equivalent. With stronger stimuli the corresponding points of the various meridians show pronounced differences with respect to functional value.

Ernst Schmerl.

Fabre, P. **Exact determination of axes of astigmatism by alignment of focal lines.** Arch. d'ophth. **8**:495-505, 1948.

The author describes a subjective method for the determination of the axes of astigmatism. He notes that the principal meridians in an astigmatic eye are perpendicular to the corresponding focal lines. Certain subjects are ametropic for one of the foci. For example, they see, without accommodating, a star in the form of a straight line. The author's method gives to the subject a method of describing a focal line which he perceives and allows him to indicate exactly the azimuths of the principal meridians of his eye. For the test two types of apparatus are necessary. The first consists of a testing lens of variable power and the second of an apparatus containing a central luminous point around which can revolve a second luminous point. This second luminous point gives a focal line parallel to the first in the field of the test lenses. The subject must be able to move the apparatus in such a way that the two focal lines lie end to end. The alignment of these two images coincides with the direction of the focal lines and the axis of astigmatism. The method by which the apparatus works is described in full detail and is illustrated with drawings. The author claims that this is a precise means of determining the axes of astigmatism and that it also gives information as to the presence or absence of aberration.

Phillips Thygeson.

Granit, R. **The off/on-ratio of the on-off-elements in the mammalian eye.** Brit. J. Ophth. **32**:550-554, Sept., 1948.

Some aspects of the micro-electrode work done with the retina of the dark adapted decerebrate cat are reported. The retinal elements are on-elements, off-elements and on-off-elements. The on-elements respond to light with a stream of impulses, the off-elements with a discharge at the cessation of illumination and the on-off-elements combine these two properties. For the discrimination of light and colors the on-off-elements predominate, and were here found to be fully 80 percent of all the elements. There was a tremendous variation in the ratio of the on and off components of the on-off-element (from 1,000 to 0.001) but the purpose of such variation is not known. In general, it is believed that it improves discrimination. It is highly probable that the slow electrical changes induced by light de-

termine the off-on ratio because electrical stimulation strongly affects this relationship. Anatomical organization is probably not fixed and unchangeable; instead the "boutons" at the synapses expand or contract so as to alter the contact surface and thus alter the function.

Morris Kaplan.

Guenther, G. **An instrument for the objective determination of the visual acuity.** Arch. f. Ophth. **148**:430-442, 1948.

Optokinetic nystagmus serves as a basis for the objective determination of the visual acuity. A frame 15 by 15 cm. is placed in front of the examined person at variable distances of one to four meters. Behind the frame a moving strip of paper presents checkerboard designs with squares 2, 5 and 10 mm. in diameter. With varying distances and varying sizes of the designs a variable visual stimulus is offered. When the stimulus passes the threshold and the moving squares can be discriminated as such, optokinetic nystagmus occurs. The normal minimum separabile determined in this way was found to equal two minutes. Ernst Schmerl.

Györffy, A., and Kahán, A. **Tolerance of contact lenses.** Ophthalmologica **116**: 1-6, July, 1948.

The wearing time of contact lenses was significantly lengthened in nine out of fifteen patients by the instillation of a mixture of 0.5-percent antistine and 0.025-percent privine before the insertion of the lenses. The history and theory of the histamine antagonists is reviewed.

Peter C. Kronfeld.

Hartridge, H., and Thomson, L. C. **Methods of investigating eye movements.** Brit. J. Ophth. **32**:581-591, Sept., 1948.

There is controversy concerning the normal existence of rapid oscillations of the eye during fixation. The precision of measurement of the movement must be within 6 seconds of arc, which corresponds to a cone unit of size. In this article a method is described in which a point of light reflected from the cornea is photographed by means of a camera mounted on a small bench which is held in the mouth of the subject. The movie film used is examined, a single frame at a time, under a microscope. (5 figures.)

Morris Kaplan.

Hecht, S., Hendley, C. D., Ross, S., and Richmond, P. N. **The effect of exposure to sunlight on night vision.** Am. J. Ophth. **31**:1573-1580, Dec., 1948. (3 tables, 4 figures, 10 references.)

Katz, J. **Supplementary observations concerning night myopia.** Klin. Monatsbl. f. Augenh. **113**:170-172, 1948.

In this short article the possible practical implications of the fact that the sensitivity of the human eye varies for various wave length are discussed. There is a difference of 0.4 diopters between the maxima of the sensitivity curves during day vision and those during night vision. This would mean that an emmetropic or fully corrected eye becomes myopic (0.4 diopter) during twilight vision. Experiments in this field are suggested, especially as the correction of optical instruments and of spectacles for night use would be of practical interest. (References.) Max Hirschfelder.

Langer, F. **My experience with the Cobalt lamp of Roessler.** Klin. Monatsbl. f. Augenh. **110**:26-32, Jan.-Feb., 1944.

The use of the Cobalt lamp of Roessler is recommended for subjective refraction. The test is simple, easy for the patient, fast and quite reliable. The patient is seated 175 cm. from the lamp. A blue disc with red margin indicates hyperopia, a red disc with blue margin myopia. Spherical lenses are put in front of the eye until the color arrangement is reversed. Mixed

astigmatism is characterized by a blue line crossed by a red line. The blue line corresponds to the myopic meridian, the red line to the hyperopic. Plus cylinders are given until the astigmatism is corrected and the eye presents a simple myopia. The same cross appears when in myopic or hyperopic astigmatism one meridian is corrected by spherical plus or minus lenses until the interfocal space is reached. By changing the distance between lamp and patient from 175 cm. to 39 cm. the amount of accommodation is tested. Patients with asthenopia exhibit an excess of accommodation. The refraction is completed by having the patient read the Snellen chart. George Brown.

Lebensohn, J. E. **Practical problems pertaining to presbyopia.** Am. J. Ophth. **32**:22-30, Jan., 1949. (3 figures, 3 tables.)

Letchworth, T. W. **Stereoscopic vision in monocular aphakia.** Tr. Ophth. Soc. U. Kingdom **66**:261-262, 1946.

The author describes his own experience with monocular aphakia. His right eye had 6/12 vision with −1.00 cylinder and the left 6/6 with a +6 sphere combined with +4.00 cylinder at 160°. He was able to get stereoscopic vision through the optical center of the cataract glass only if the head was not moved. The area was gradually increased by sitting before a tangent scale and moving the eyes up, down and laterally. A prism controlled bifocal was not quite so comfortable and he advises the Franklin type. He suggests occluding the periphery of one lens by an opaque material or ground glass and leaving only the central portions free for binocular vision. Beulah Cushman.

Lorenz, R. **Aniseikonia. A simple method for measuring it.** Klin. Monatsbl. f. Augenh. **110**:16-25, Jan.-Feb., 1944.

Two pictures, one green and the other red, are displayed on a stereoscope. In aniseikonia the binocular picture is slanted. The percentage of aniseikonia is figured from the angle of slanting.

One hundred fifty-four persons were tested. None of the emmetropic patients had aniseikonia. Therefore, the author questions the existence of a functional aniseikonia. In the myopic group aniseikonia was found only when there was a difference in the refraction. The aniseikonia disappeared when normal binocular vision was obtained with full correction, but persisted when full correction was impossible. In hyperopia aniseikonia was the more frequent and the more marked the greater the difference between the two eyes and the poorer the vision. However, there is no direct proportion between the amount of aniseikonia and the error of refraction. In practice aniseikonia is not too important. It is most frequent and most marked in patients who have poor stereoscopic vision and who, therefore, are not greatly bothered by the aniseikonia. In persons with well developed stereoscopic vision aniseikonia is comparatively infrequent or small. When there is considerable difference between the eyes the patient usually uses one eye only. Such patients, when fully corrected and with good vision of both eyes, complain about dizziness and slanting due to the now apparent aniseikonia. In hyperopia poor vision of one eye or poor stereoscopic vision often prevent the appearance of aniseikonia. There may be complete suppression of one eye in order to avoid aniseikonia. George Brown.

Marchesani, O., and Schober, H. **The action of lactoflavine upon the color vision.** Arch. f. Ophth. **148**:420-429, 1948.

After intravenous or intramuscular injections of 10 mg. of lactoflavine the authors found a significant enlargement

of the visual fields for red in 47 persons. Ernst Schmerl.

Melanowski, W. H. **The simple method of calculation of the optic system in high anisometropia.** Tr. Ophth. Soc. U. Kingdom **66**:263-264, 1946.

Formulas are given for the calculation of the change in size of image made by telescopic spectacles for distance and near. Beulah Cushman.

Miles, P. W. **Refractive treatment of asthenopia.** Am. J. Ophth. **32**:111-121, Jan., 1949.

Pacalin, G. **Physiologic diplopia.** Ann. d'ocul. **181**:604-612, Oct., 1948.

Diplopia begins with the stimulation of noncorresponding retinal areas. Binocular integration as well as projection, or fusion, are largely accomplished in the peri- and para-striate areas that Brodman has numbered 18 and 19. The subsequent course of binocular visuomotor impulses is not accurately known. Memory impressions, however, largely determine our interpretations of size, form and distance. The well-known steps of Schroeder demonstrate that visual interpretation is not technically correct. Chas. A. Bahn.

Papagno, M. **Acetylcholine effective in a case of spasm of accommodation.** Boll. d'ocul. **27**:464-470, July, 1948.

A 17-year-old girl with dysmenorrhea associated with headache, abdominal pain, cardiac palpitations, vomiting, vertigo, and diarrhoea since she was 14, noticed a blurred vision for distance during her two last menstrual periods. Examination revealed normal eyes and retinoscopic refraction of three diopters of miopia. With a −3.00 D. lens, she could read 10/10. Intramuscular acetylcholin injection immediately reduced the spasm from three diopters to one and soon after to emmetropia. The next menstrual period was accompanied by a slightly milder spasm of accommodation and again relieved by intramuscular acetylcholin. K. W. Ascher.

Sauter, H. **Origin and observation of the shadows seen in sciascopy.** Arch. f. Ophth. **148**:529-543, 1948.

This is a presentation for the practitioner and the teacher of what is known about the phenomena of sciascopy. Ernst Schmerl.

Siebeck, R. **The form-threshold problem of optical stimuli.** Arch. f. Ophth. **148**: 443-458, 1948.

If two figures, say a circle and an equilateral triangle of the same area and color, are compared with each other, the triangle appears to be larger than the circle, whereas the color of the circle appears to be more saturated than that of the triangle. Starting from these observations, the author studied the form-threshold problem. He finds a definite relationship between shape and threshold values of the offered stimuli. The field which surrounds stimuli of varying sizes but similar shapes becomes more important the smaller the objects are. This is probably due to the increasing ratio of circumference to area. Unavoidable ocular movements cause differences in local retinal adaptation with different stimuli of the same area but of different shapes. Because of this factor a quantitative correlation between form and threshold cannot be satisfactorily presented. However, it is safe to say the shape of a visual stimulus affects the threshold sensitivity, although the size of the object is of much greater importance. Ernst Schmerl.

Sinclair, A. H. H. **Developmental aphasia.** Brit. J. Ophth. **32**:522-531, Sept., 1948.

Developmental aphasia is a failure of visual comprehension probably caused by delayed development of unilateral hemispherical dominance. Letters and words are seen but are not recognised but aural perception remains unaffected and is of great use to the affected children. The condition may be mild and transitory or severe and difficult to overcome. There is a natural tendency to recover which increases progressively with the child's development and education.

The important diagnostic criterion is the brightness of the child in other processes of learning. He can easily read numbers, music or pictures and learns easily by ear but cannot appreciate the printed word. There is most probably an absence or a delay in the myelinization of the neurons going to the exteroceptive centers in the cerebral cortex. Treatment consists of meticulous training by parents and teachers and almost always brings good results.

In the Edinburgh Primary Schools about 10 percent of the children had developmental aphasia, of whom half recovered in the ordinary course of education and half required special treatment. Morris Kaplan.

Starke, H. **Changes of corneal astigmatism following instillations of eye drops.** Arch. f. Ophth. **148**:544-554, 1948.

The author used Hartinger's ophthalmometer as manufactured by Zeiss to measure the radii of corneal curvature in about 40 persons. The instrument permits a determination of the radius with an error of not more than ± 0.01 mm. The radii of normal corneas of younger people show changes of several hundredths of a millimeter caused by variation of the ocular tension and the pressure of the eyelids. With instillations of atropine corneal astigmatism usually decreases, with pilocarpine it increases. Ernst Schmerl.

Tschermak-Seysenegg, A. **One hundred years of "Haidinger brushes."** Klin. Monastbl. f. Augenh. **113**:167-169, 1948.

One hundred years ago the mineralogist Haidinger discovered the appearance of a figure like a double-sheaf in polarized light, afterward called "Haidinger's bundles or brushes." The cause for this phenomenon which appears only in light of short wave length is the presence of doubly refracting fiber elements in the macular region of the human retina. The phenomenon serves also as proof for the polarization of the light of the sky which is vertical to the apparent course of the sun. Using doubly refracting prisms before each eye one can use the phenomenon of these brushes for tests of binocular vision. (References.)
Max Hirschfelder.

Weston, H. C. **The effect of age and illumination upon visual performance with close sights.** Brit. J. Ophth. **32**:645-653, Sept., 1948.

Twelve patients of different ages were studied while performing a series of special visual tasks that involved the perception of fairly small detail. Each task was repeated with different degrees of illumination. Each subject had previously been refracted and fitted with necessary glasses and all read fine print with their glasses. They were arranged in five age groups, from 24 to 48 years. The task consisted in finding all the similarly placed gaps in a series of Landolt rings and results were recorded as time per correct ring. Although age had no effect on visual acuity, there was definite and regular effect of age on visual efficiency. The rate of decline is fairly consistent and amounts to about five percent per annum. The effect of illumination changed greatly with age; a change from the lowest to the highest illumination tried increased the performance of the

youngest subjects only 18 percent but it increased the performance of the oldest subjects 400 percent. In addition, it was noted that with the lowest illumination and the finest visual task, the performance of the 24-year-olds was as good as that of subjects of 47 years with the easiest visual task and the highest illumination. Morris Kaplan.

5

DIAGNOSIS AND THERAPY

Albright, A. A. **An economical screen.** Am. J. Ophth. **32**:126, Jan., 1949. (1 figure.)

Anthony, D. H., and Fisher, D. F. **Evaluation of X-ray diagnosis in ophthalmology, rhinology and otolaryngology.** Mississippi Doctor **26**:79-89, Sept., 1948.

The authors indicate the conditions in which X-ray diagnosis is helpful and make it clear that the ophthalmologist is for the most part quite unaware of the not inconsiderable help that the X-ray can give him. F. H. Haessler.

Atkinson, W. S. **Local anesthesia in ophthalmology.** Am. J. Ophth. **31**:1607-1618, Dec., 1948. (17 figures, 13 references.)

Berens, Conrad. **Lens loop with serrations, longitudinal wires and flexible shaft.** Am. J. Ophth. **32**:122-123, Jan., 1949. (3 figures.)

Carlevaro, Gianfranco. **A clinical form for the functional examination of the eye.** Ann. di ottal e clin. ocul. **73**:442-446, July, 1947.

A four-page blank form is described and recommended for use in making a detailed systematic examination of the ocular functions. The various tests are outlined. (35 references.)
Harry K. Messenger.

Durham, D. G. **The new ocular implants.** Am. J. Ophth. **32**:79-89, Jan., 1949. (12 figures.)

Engel, Sam. **A new model contact lens. For observation of the eyeground and of the posterior part of the vitreous with the slitlamp.** Am. J. Ophth. **32**:123-125, Jan., 1949. (2 figures.)

Filatov, V. P. **Some considerations on therapy with tissues.** Arq. brasil de oftal. **11**:103-121, 1948.

This is a Portuguese translation from the author's paper in the Russian Vrachnoe Delo, 1945, dealing with the author's experiments in subconjunctival insertion of fragments of tissue from other parts of the body, for the purpose of producing a beneficial reaction in cases of uveitis and other conditions. W. H. Crisp.

Foddis, Antonio. **A simple device for adapting the Zeiss stereoscopic camera (for photography of the anterior segment) to photokeratoscopy.** Ann. di ottal. e clin. ocul. **73**:332-335, June, 1947.

A device embodying a Placido's keratoscopic disk is described. For ordinary keratoscopy Foddis uses a Placido's disk that has two openings in place of the usual central one so that he can study the keratoscopic reflex binocularly. (3 figures.) Harry K. Messenger.

Fried, Carl. **Roentgen and radium therapy in ophthalmology.** Ophth. ibero am. **9**:323-344 (Portuguese), 345-366 (English), 1948.

The results briefly described by the author relate to 28 cases of inflammation of bacterial and 49 of nonbacterial origin, and to 23 of malignant and 5 of benign neoplasms. All patients were treated in the São Francisco de Assis Institute (Brazil). Rather diffuse claims are made for benefit in the inflammatory diseases

and in painful blind glaucomatous eyes. Brief comments are made as to papers published by other authors.

W. H. Crisp.

Gut, A. **Indirect illumination in direct ophthalmoscopy.** Ophthalmologica **116:** 79-85, Aug., 1948.

The conventional method of direct ophthalmoscopy utilizes diffusely reflected light. Indirect illumination is obtained if, by means of an adjustable condenser, the borders of the directly illuminated portion of the retina are sharply focused. The portion of the fundus adjacent to the directly illuminated area can now be examined in indirect light. The method is especially revealing in diseases of the macula. In such cases the light source or its equivalent (the diaphragm of the ophthalmoscope) is brought to a sharp focus below or temporally to the macula while the latter is studied for minute pathologic changes. Six instructive cases are described and depicted. An ophthalmoscope with variable angle between the axes of the illuminating and the observation system is especially suitable for examination in indirect light. The author's main point is that this simple and widely known method is not used as much as it deserves.

Peter C. Kronfeld.

Landers, P. H. **Simplified external eye photography.** Am. J. Ophth. **31**:1624-1625, Dec., 1948. (3 figures, 5 references.)

Lijó Pavía, J. **Papillary edema; comparative study with sodium light.** Rev. oto-neuro-oftal. **23**:45-51, July-Sept., 1948.

Two cases of papillary edema are presented, one due to malignant arterial hypertension and the other a sequel of hypophyseal tumor. The fundus was studied in ordinary white light, red-free light, and sodium light. With yellow light, in the case of malignant neuroretinitis, the vessels were well demarcated, superficial precapillaries and peripapillary lipoidal deposits were visible and the macula was more precise, though the fovea could not be delimited. In the second case, too, sodium light ophthalmoscopy resulted in finer visualization of the vascular system and the exudative deposits. (5 figures.)

Edward Saskin.

Morgan, O. G. **The value of vitamins in ophthalmology.** Medical Press **220**:385-389, Nov. 10, 1948.

Many serious diseases of the eyes are associated with poor general health. It is usually worth while to supplement local treatment with vitamins B and C. The outstanding effect of vitamin A deficiency is xerosis and night blindness. Retrobulbar neuritis and increased corneal vascularization may be due to thiamine deficiency. Rosacea keratitis responds to riboflavin therapy. Ascorbic acid has been used in corneal ulcer and keratitis of various types with satisfactory results. Vitamin D regulates calcium and phosphorus metabolism. Vitamin D has been suggested in myopia in the child. Rutin or vitamin D decreases capillary fragility. It neutralizes the effect of potassium thiocyanate in hypertension. I. E. Gaynon.

Pérez Toril, Francisco. **Penicillin in ocular diseases.** Arch. Soc. oftal. hispano-am. **8**:833-838, Aug., 1948.

From his experience with the use of penicillin in 87 cases of ocular disease, Pérez concludes that penicillin is of great value in ophthalmology. Its employment is not necessary in diseases easily amenable to other forms of therapy but should be used promptly when irreparable damage seems immanent. Intramuscular and intravenous administration is adequate for extraocular lesions but intraocular lesions require subconjunctival, intra-

vitreal, and intracameral administration in addition to the use of collyria, ointments and baths. Agents for local application should contain not less than 500 units and not more than 10,000 units per cc. of solution. The early use of penicillin has modified the grave prognosis formerly associated with such diseases as gonorrheal ophthalmia and serpigenous ulcer.
Ray K. Daily.

Ploman, K. G. **Examination of the media of the eye with a plane mirror combined with a loupe, in severe myopia. An improvement in the method.** Acta ophth. **26**:213-214, 1948.

Ploman found that improved visibility is obtained by correcting the myopia with a minus lens held in front of the eye.
Ray K. Daily.

Rosengren, Bengt. **A method of sciascopy with the electric ophthalmoscope.** Acta ophth. **26**:215-221, 1948.

The technique of sciascopy with the electric ophthalmoscope is described in detail. The advantages are the possibility of sciascopy with an undilated or constricted pupil, and the rapidity of the procedure. (2 figures.) Ray K. Daily.

Saint-Martin, R. **Tissue therapy in complicated myopia.** Ann. d'ocul. **181**: 578-587, Oct., 1948.

Filatov's technique for placental subconjunctival implants and intramuscular infiltrate injections was closely followed. In the use of the former, 5 inclusions at 8 to 15-day intervals were made, of the latter 30 injections at 2-day intervals were made. In a series of 30 patients, all received both types of treatment. There was definite subjective improvement in 8, appreciable improvement in 14, doubtful improvement in 6, and failures in 2. The author suggests that this treatment be tried experimentally more extensively.
Chas. A. Bahn.

Siboni, B. **The virtues of sulfanilamide powder in ophthalmology.** Ann. d'ocul. **181**:629-644, Oct., 1948.

In North Africa sulfanilamide powder has numerous advantages over solutions or ointments in a wide range of ophthalmic conditions such as exogenous infectious and traumatic diseases of the lid, conjunctiva, sclera and iris, and bacterial, viral, and rickettsial infections, such as trachoma. Chas. A. Bahn.

Sykowski, P., and Lawrence, W. **Streptomycin in ophthalmomiliary tuberculosis.** Am. J. Ophth. **31**:1629, Dec., 1948.

Vannas, Mauno. **The diagnosis of intraocular tumors and foreign bodies by means of anterior pupillary transillumination.** Acta ophth. **26**:125-134, 1948.

The limitations of posterior bloodless diascleral transillumination and of posterior transillumination with the transilluminator introduced far back through a conjunctival incision are discussed. The main source of error is the uncertainty of the position of the transilluminator in relation to the tumor. In addition, in diascleral transillumination the pupil becomes illuminated only if the eye of the examiner is within the light cone whose point is formed by the point of the lamp and whose aperture is the pupil. If the examiner moves his head, or the patient his eye the iris comes between the lamp and the eye of the examiner, and the pupillary reflex is complicated by two shadows, that of the tumor, and that of the iris. Transillumination through the pupil with the transilluminator applied directly to the cornea is superior. Also, with this method, experiments in transillumination on enucleated eyeballs demonstrated that shifting the point of light

from the center of the cornea over the iris greatly reduces the transillumination of the sclera. Pupillary transillumination is of value also for localizing purposes in cases of foreign bodies in the wall of the eyeball or its vicinity. Foreign bodies in the wall of the eyeball or in contact with the inner surface of the retina are recognized by distinct shadows; when the experimental object is transferred inward into the virtreous its shadow becomes less distinct. Clinical case reports illustrate the superiority of pupillary over diascleral transillumination. Ray K. Daily.

Velhagen, K. **Technical arrangement for the dark adaptation test.** Klin. Monatsbl. f. Augenh. **113**:170, 1948.

The author recommends a lightproof cabinet which can be arranged in the corner of any room. The patient sits within the cabinet and observes the adaptometer, which is built within the side of the cabinet and can be regulated from the outside. Such an arrangement leaves the examiner free for other duties during the time-consuming test.

Max Hirschfelder.

6

OCULAR MOTILITY

Abraham, S. V. **A new classification of nonparalytic strabismus** Am. J. Ophth. **32**:93-98, Jan., 1949. (1 table, 19 references.)

Anderson, J. R. **Sidelights on the inferior oblique muscle.** Brit. J. Ophth. **32**: 653-667, Sept., 1948.

This detailed discussion of the inferior oblique muscle emphasizes the need of a knowledge of its anatomy and physiology in adequate diagnosis and selection of treatment of its disorders. Its insertion into the sclera is oblique and about 10 mm. in length which lies in and below the horizontal meridian. It is under the external rectus, its anterior end being 2 mm. above the lower level and almost 10 mm. behind the insertion of the external rectus. Its insertion extends to a point 4 mm. from the fovea. Its function is considered to be 56.1-percent extorsion and 42.9-percent elevation. The very early anatomists called the inferior obliques the amatorii or lovers' muscles since rolling of the eyes were signs of affection.

Often in diagnosis the malfunction of a muscle is ascribed to overaction, underaction or palsy of the inferior oblique when actually the contralateral or homolateral antagonist or yoke muscle is defective. The surgeon must be very careful to correct large horizontal errors before he deals with most vertical defects, as the latter may then become only negligible sources of disfunction. (38 references.) Morris Kaplan.

Angius, Tullio. **The treatment of the heterophorias.** Rassegna ital. d'ottal. **17**: 190-196, May-June, 1948.

While employing acetylcholine in the treatment of chorioretinitis and accommodative spasm, the writer noted a regression of the concomitant heterophorias. The subjects reported upon in the article were in good health and were emmetropic. The muscle balance was studied by various methods, among them with Maddox rod, stereoscope and prisms. The subjects were divided into five groups according to the medication administered. The first group received daily intramuscular injections of acetylcholine bromide, the second prostigmin intramuscularly, the third intravenous vitamin B_1, the fourth d-phenylisopropylmetilamine chloride, and the fifth group vitamin A, 100,000 units and D 25,000 units by mouth.

It was observed that fatigue, even though not excessive, caused an aggravation of the heterophoria, especially in older subjects. Heterophoria was often associated with spastic conditions else-

where, in the colon, for example. Excellent results were obtained in the patients receiving prostigmin and those getting vitamin B_1, either alone or combined. Esophorias showed a greater tendency to recur than other phorias. The treatment was more effective than orthoptic measures, but in the more severe cases a combination of the two yielded better results.

Eugene M. Blake.

Apin, K. **Exercises in strabismus.** Klin. Monatsbl. f. Augenh. 110:62-67, Jan.-Feb., 1944.

The first important step is the measurement of refraction after instillation of atropine for three successive days. Full correction with the eyes still under the action of atropine is indicated and permanent occlusion, if amblyopia of one eye is found. Next the strabismus should be eliminated, if necessary by surgery. Exercises are kept up for years in order to reestablish binocular and stereoscopic vision.

George Brown.

Da Pozzo, Ezio. **A case of post-traumatic synkinesia oculo-oculare.** Giorn. ital. di oftal. 1:265-273, May-June, 1948.

In a girl cranial trauma initiated a synkinesia oculo-oculare (blepharoptosis of one side associated with contraction of the contralateral medial rectus). The author discusses briefly the hypotheses advanced in explanation of congenital and acquired synkinesis with involvement of the levator palpebrae. He concludes that none solves the problem of the pathogenesis of this picture.

Francis P. Guida.

Gasteiger, H. **Rare complications after surgery for strabismus.** Klin. Monatsbl. f. Augenh. 113:152-157, 1948.

Postoperative complications after surgery for strabismus are rare. Three cases in which severe inflammation and necrosis of the sclera developed in the operative area after tenotomy or advancement are described. In one a deep keratitis also developed but it finally healed with severe loss of vision due to the scar. One of the three eyes had to be enucleated, whereas the other two could be saved through removal of the necrotic conjunctival and scleral tissue and covering of the defect by a flap of conjunctiva and Tenon's capsule. The author believes that these complications are nutritional and due to disturbances of the blood supply. He points out that the anterior ciliary arteries enter the bulbus in this region and that they suffer damage during surgery. The other possibility is infection of the operative field. Lowered resistance in the patients may have contributed to the abnormal course. (References.)

Max Hirschfelder.

Hartmann, E. **Physiology of ocular motility, heterophoria and strabismus.** Ann. d'ocul. 181:449-462. Aug., 1948.

Ocular motility, normal and abnormal, involves coördinated, binocular, three-dimensional alignment as well as motion. As practically all ocular motility is subconscious, its quantity and quality are governed by numerous reflexes in which the eyes play a more or less dominant part. For example, postural reflexes include both static and dynamic types. The former involves the "righting" and altitudinal reflexes which are primarily located below the cerebral peduncles. Static-kinetic reflexes involve binocular alignment associated with head rotation. They are involved in nystagmus following especially rapid head rotation and are primarily located in the semicircular canals and vestibular nuclei. Retinal reflexes form part of the sensorial reflex mechanism which also includes smell, hearing, touch and taste and which is an important factor in reflex ocular motility. The visual reflexes involved in binocular alignment and motility include the fol-

lowing: "righting," direction, compensating, fixation, retinal orientation and convergence reflexes. The convergence reflex, the most recently acquired, is most frequently involved in strabismus. It is essentially a conditioned reflex and the others are true or unconditioned. The 45-degree deviation of the axes of the orbits from parallelism results in differences of alignment which are compensated in the phorias but not in the tropias. Muscular anomalies alone, as in the Duane syndrome, seldom play a dominant part in strabismus. It usually is a manifestation of imperfectly coördinated reflexes which produce disalignments. All treatment, surgical and other, should be designed primarily to coördinate faulty reflexes rather than increase or decrease the power of a muscle. (13 references.)

Chas. A. Bahn.

Law, F. W. **A point for consideration in the use of the stereoscope.** Brit. J. Ophth. **32**:639-644, Sept., 1948.

Heretofore the answer to the question "what happens to the inclination of the visual axes on moving the stereogram in a stereoscope towards or away from the observer?" has simply been guessed at. From studies involving the interocular distance, the distance of the card from the viewer, the width of the stereogram and the strength of the lenses in the stereoscope, the author found that the instrument could be used for exercise either of convergence or divergence but to be successful the examiner must understand the principles exactly. With this in view, tables are presented to keep the necessary data perspicuous.

Morris Kaplan.

Riise, Per. **Surgical treatment of vertical squint.** Acta ophth. **26**:153-165, 1948.

The field of surgery of the vertical and oblique muscles has widened. Elschnig's book on surgery in 1922 speaks of these operations as rare. In Thiel's recent book the surgical indication is a squint of more than 5 degrees. The results of surgery for vertical strabismus are shown by case reports illustrated with photographs and diplopia charts. (31 figures.)

Ray K. Daily.

Spaeth, E. B. **The vertical element in the causation of so-called horizontal concomitant strabismus. Surgical principles for the vertical corrections.** Am. J. Ophth. **31**:1553-1566, Dec., 1948. (21 figures.)

Toth, Zoltan. **Forcepts in resection of a muscle.** Klin. Monatsbl. f. Augenh. **110**: 67-68, Jan.-Feb., 1944.

The use of a forceps in advancement or resection of a muscle has many disadvantages. The instrument is too big for the small field and the trauma to the muscle is considerable. A simple bridle suture through the muscle before the insertion is cut serves the same purpose and is technically preferable.

George Brown.

Weekers, L., and Weekers, R. **A monocular operation for severe divergent strabismus.** Ann. d'ocul. **181**:493-499, Aug., 1948.

A provisional attachment is made of the internal rectus tendon across the cornea to the external rectus tendon. In very high degrees of strabismus tenotomy of the external rectus is also performed. In strongly amblyopic divergent eyes, this operation is recommended from a cosmetic point of view as simple and safe. Anesthesia includes local instillation and retrobulbar injection, without conjunctival infiltration. The external rectus muscle is raised with a forceps and a double thread is passed between the sclera and the muscle immediately behind the tendon, forming a strong support for traction. The conjunctiva over the internal rectus is then dissected, sutured,

and sectioned. The conjunctiva and tendon are placed across the cornea and are sutured to the tendon of the external rectus. Both sutures are now united. The conjunctiva and advanced internal rectus tendon cover the cornea. After seven days the sutures and the tongue of conjunctiva are removed.

The advantages of this procedure are its simplicity and safety in all types of divergent strabismus of 25 to 35 degrees or more. (9 references.) Chas. A. Bahn.

Wilhelm, G. **Treatment of amblyopia.** Klin. Monatsbl. f. Augenh. **110**:56-62, Jan.-Feb., 1944.

In 11 children, 2 to 10 years old, with strabismus and amblyopia of one eye, improvement followed permanent occlusion in 90 percent in two to four weeks. Normal vision was achieved in 11 percent of those whose initial vision was 5/10, in 70 percent with vision of 5/25 and in 34 percent with less than 5/50. The necessary time of occlusion was independent of the age, but longer with lower initial vision. Treatment of amblyopia should be started before the sixth year, but is possible after this age. In 42 percent the amblyopia recurred, especially in children of two to four years. After repeated occlusion, lasting results were eventually attained in 85 percent of patients. Subsequent amblyopia of the occluded eye occurred in 46 percent of the two to four year old children, never after the sixth year. In 46 percent the strabismus disappeared after elimination of the amblyopia and prescription of glasses.

George Brown.

7

CONJUNCTIVA, CORNEA, SCLERA

Alvarez Alvarez, Abundio. **The therapy of herpetic ocular diseases.** Arch. Soc. oftal. hispano-am. **8**:687-698. July, 1948.

The literature on the numerous therapeutic agents used in these conditions is reviewed, and three cases of herpetic keratitis treated with applications of an alcoholic solution of iodine and potassium iodide are reported. One case of herpes zoster ophthalmicus responded to the administration of chromesulfur.

Ray K. Daily.

Anderson, Banks. **Corneal and conjunctival pigmentation among workers engaged in manufacture of hydroquinone.** Arch. of Ophth. **38**:812-826, Dec., 1947.

Observations are presented on a group of workers employed in the manufacture of quinone and hydroquinone in whom certain characteristic lesions of the cornea and conjunctiva have developed. These lesions consist of a variable degree of pigmentation of the interpalpebral portions of the conjunctiva and cornea, proportional to length of employment and to age and corneal changes. These corneal changes consist in pitting and erosion of the corneal surface, thinning of the cornea, development of irregular pigmented or staining areas, wrinkling or modification of Descemet's membrane and, possibly, keratoconus. The changes are apparently reversible up to a certain point in that conjunctival staining may disappear. The corneal stain is more permanent. The lesion could not be produced in albino rabbits. While the chemical is said not to belong to the carcinogenic group, some of the lesions resemble Bowen's disease. The development of a frank malignant growth is not beyond the bounds of probability. John C. Long.

Bakker, A. **A myxo-haemangioma simplex of the conjunctiva bulbi.** Brit. J. Ophth. **32**:485-88, Aug., 1948.

A pedunculated hemangioma of the conjunctiva under microscopic examination showed intensive growth with mitotic figures and myxomatous degenera-

tion. There has been no recurrence eight months after simple excision.

Orwyn H. Ellis.

Blodi, F. **A case of a horizontal Krukenberg splindle.** Acta. ophth. **26**:373-378, 1948.

A case of bilateral horizontal Krukenberg spindle is reported in a woman 76 years old. The spindle was demarcated by a glassy line situated in the posterior corneal layers and visible only in indirect light. There was no other abnormality in the eyes. The etiology is believed to be a change in Descemet's membrane, limited by the glassy line. Although the change could not be demonstrated biomicroscopically it is believed that colloidochemical changes in the endothelial cells could account for the deposit of pigment on the posterior corneal surface.

Ray K. Daily.

Bonavolontà, Aldo. **Biomicroscopic examination of the limbus as a basis for a new classification of the various stages of trachoma.** Giorn. ital. di oftal. **1**:207-226, May-June, 1948.

The author studied the corneal manifestations said to be pathognomonic of trachoma. These manifestations may be grouped into quite variable complex pictures. Several groups are of very little interest, namely the sign of the crescent, the kaleidoscopic sign, and the disappearance of the primary sulcus; others are of definite value, namely the accelerated development of the terminal limbal loops, and the superficial neovascularization with the characteristic accompanying infiltration. Of greatest value are the nodules and their residua. He points out the value of biomicroscopic examination of the limbus to reveal and evaluate these manifestations and to establish the diagnosis of trachoma from its incipiency to its end. He noted several cases in stage 1 and 2 with corneal signs and others without. It seems important to him to establish a classification based on the biomicroscopic findings which takes into consideration the conjunctival and corneal picture. He suggests one in which T_a includes T_1 and T_2 of MacCallan, without corneal signs of trachoma, T_b consists of those cases in T_1 and T_2 which show corneal signs, and T_c consists of cases in T_3 and those in T_4 in which examination of the cornea shows active trachoma. The fully evolved trachoma, both corneal and conjunctival is known as T_d.

Francis P. Guida.

Brand, E. **A new quick staining procedure of the inclusion bodies of trachoma.** Orvosi Hetilap **26**:405-406, 1948.

Report on a new, simple and quick procedure lending itself to demonstration of the inclusion bodies of trachoma. A 1-percent solution of toluidine blue stains the inclusion bodies with due contrast in one-half minute. Gyula Lugossy.

Brand, E. **A new quick staining method for trachoma inclusions.** Ophthalmologica **116**:61-63, July, 1948.

The material is spread on a clean slide, allowed to dry at room temperature, fixed in absolute alcohol for ½ minute, dried again and stained with a 1-percent aqueous solution of toluidine blue for two minutes. The author believes that the trachoma inclusions are actually a part of the Golgi network altered by the trachoma virus. Peter C. Kronfeld.

Busacca, A. **Certain corneal diseases observed under the influence of penicillin therapy.** Ophthalmologica **116**:43-50, July, 1948.

The author describes his experiences with penicillin applied topically in diseases of the lids, conjunctiva and cornea.

He reports good results with penicillin injections (5,000 units per cc.) into the lid in cases of severe chronic blepharitis. He uses the same technique for hordeola. The course of a large portion of infectious ulcers of the cornea is rapidly and beneficially changed by repeated subconjunctival injections of penicillin. Specifically, he describes two types of keratitis which have responded surprisingly well to subconjunctival penicillin therapy. He proposes the term "keratitis epithelialis desquamativa" for the first type which is characterized by epithelial infiltration and ulceration in the form of small dots arranged in lines or coalescing into larger spots with irregular (geographic) borders. The disease takes a chronic course and may be resistant to all conventional forms of therapy. Busacca has cured two such cases with daily subconjunctival injections of penicillin continued for approximately four weeks. For the other type of keratitis which belongs to the phlyctenular group, Busacca proposes the term "keratitis with polymorphous efflorescenses." The first type has been thought to be of herpetic and the second type of allergic origin. In the light of their favorable response to penicillin Busacca believes that the views concerning their pathogenesis will have to be revised.

Peter C. Kronfeld.

Colditz, Heinz. **Keratoconus, operated on according to Sato.** Klin. Monatsbl. f. Augenh. 110:233-234, March-April, 1944.

In an eye with rapidly progressing keratoconus in a 25-year-old woman, a discission-knife was introduced and three vertical incisions were made in Descemet's membrane in the area of the conus. The swelling and opacity of the involved area subsided very slowly. Nine months later the curvature of the cornea was almost normal. There was a dense scar at the site of the former apex. The cornea here was much thicker than before the operation. George Brown.

Coverdale, H. **Some unusual cases of Sjögren's syndrome.** Brit. J. Ophth. 32: 669-673, Sept., 1948.

Sjögren's syndrome (keratitis sicca) is part of a general systemic disturbance of unknown origin. There seems to be no common causative factor. Probably a majority of cases occur in women near the menopause. The case histories of five patients are presented whose eyes had the typical manifestations but whose histories were somewhat unusual. Two occurred in a man and his daughter who had had dry eyes all their lives. The daughter showed signs of pituitary dysfunction. Two others occurred in a woman and her tuberculous daughter, and the fifth in a young woman whose symptoms seemed to originate from a fracture at the base of the skull. Morris Kaplan.

Edström, G., and Österlind, G. **A case of nodular rheumatic episcleritis.** Acta ophth. 26:1-6, 1948.

In the course of a chronic destructive polyarthritis a patient developed a bilateral nodular episcleritis with a secondary rise in tension. Two nodules were excised from the left eye; one was subjected to histologic examination, and the other was used in a guinea pig test and culture on Loewenstein's medium. The tests for tuberculosis were negative. The nodules were covered with a normal conjunctival epithelium and consisted of granulomatous tissue; collagenous fibrils radiated from the periphery toward the center, which was necrotic. There were collections of large bright, fibroblastoid cells in the periphery and the adjacent fibrous tissue was infiltrated with plasma cells. The disease was fatal and at autopsy in addition to the lesions in the joints

rheumatic granulomas were also found in the myocardium. (2 figures.)

Ray K. Daily.

English, P. B., and White, J. Mc. B. **Corneal transplantations.** M. J. Australia **1**:736-738, June 12, 1948.

The most popular operation is described as a circumscribed penetrating keratoplasty 4 to 6 mm. in diameter. A brief review of the methods used by Castroviejo, Thomas, Filatov, and Weiner and Alvis is given. Corneal transplantation is most likely to succeed when there is no increase in ocular tension, and when the only lesion in the eye is a partial leucoma of the cornea. Aphakia, extensive corneal opacity, increased ocular tension, and corneal vascularization are all unfavorable factors.

An iridectomy should be done if there are synechia which may complicate the surgery. The donor eye should be a young one and if removed from a cadaver should be obtained within 24 hours after death. Eyes doomed to failure become cloudy and vascularized early. Negroid and caucasian corneas may be interchanged. The only case operated in a member of the Australian fighting forces is described. A visual acuity of 6/36 was obtained two months after surgery.

H. C. Weinberg.

Fadda, A., and Zambetti, E. **The prophylaxis of ophthalmoblennorrhea by use of penicillin ointment.** Rassegna ital. d'ottal. **17**:207-217, May-June, 1948.

The authors at first used an ointment containing 500 units of penicillin per gram of a vaseline base and kept refrigerated. Later a thermolabile ointment was produced which was not subject to hydrolytic influence. These ointments were employed in a large series of newborn infants for a period of a year. The ointment was inserted into the conjunctival sac immediately after birth and its use continued twice a day for five days. In only two instances was there any acute conjunctivitis and these responded to a two-hour use of the ointment. In no case was any irritation noted in the conjunctiva, cornea or lids. The year's experience with the special anhydrous penicillin ointment demonstrated that it was a good substitute for silver nitrate in the prophylaxis of ophthalmia of the new-born.

Eugene M. Blake.

Jirman, J. **Treatment of rosacea keratitis.** Ann. d'ocul. **181**:475-484, Aug., 1948.

The process may be marginal or central or both, and nodular or tongue shaped. There is usually corneal infiltration and progressive or recurrent ulceration, and necrosis and vascularization are variable. The differential diagnosis includes other degenerative, low grade or inflammatory diseases such as scrofula, tuberculous lesions and Mooren's ulcer. Several factors take part in the cause, such as a constitutional predisposition, vasomotor degeneration, exposure to physical or chemical irritants, skin parasites such as the demodex folliculorum and such body catalysts as sex hormones and vitamins, especially riboflavin.

A case of rosacea keratitis in both eyes of a 50-year-old woman is discussed in detail. A conjunctival flap over the diseased area arrested its progress, especially in one eye. Chas. A. Bahn.

Lee, O. S., Jr., and Lee, A. **Keratoplasty. I. A preliminary report on development of instruments.** Am. J. Ophth. **32**:71-78, Jan., 1949. (9 figures.)

NEWS ITEMS

Edited by Donald J. Lyle, M.D.
601 Union Trust Building, Cincinnati 2

News items should reach the editor by the 12th of the month

Deaths

Dr. Warren Douglas Horner, San Francisco, died October 22, 1948, aged 58 years.

Dr. David L. Tilderquist, Duluth, Minnesota, died September 26, 1948, aged 76 years.

Dr. Edward Andrew Weisser, Pittsburgh, died October 18, 1948, aged 72 years.

Announcements

Oregon postgraduate convention

The 10th annual spring postgraduate convention in ophthalmology and otolaryngology will be held in Portland, Oregon, June 19 to 24, 1949. Guest speakers who will appear on the fine program, arranged by the Oregon Academy and the University of Oregon Medical School, will be: Dr. Lawrence R. Boies, professor of otolaryngology, University of Minnesota Medical School; Dr. Leland Hunnicutt, associate clinical professor of otolaryngology, University of Southern California; Dr. James H. Allen, professor of ophthalmology, Iowa State University School of Medicine; and Dr. Edmund B. Spaeth, professor of ophthalmology, Graduate School of Medicine, University of Pennsylvania.

In order to make the course more personal and practical, registration will be limited to 125. For preliminary programs and full information, write to: Dr. David D. DeWeese, 1216 West Yamhill Street, Portland 5, Oregon.

Keratoplasty symposium

A two-day symposium on keratoplasty will be held in the lecture room of the Manhattan Eye, Ear, and Throat Hospital, 210 East 64th Street, New York City, on April 19th and 20th.

This conference will consist of operative clinics on the morning of April 19th, follow-up clinics on the morning of April 20th, papers by men from the United States and abroad on the afternoon of April 19th, and on the afternoon of April 20th, a round-table discussion.

Orthoptic examination

Application for the examinations to be conducted by the American Orthoptic Council during September and October, 1949, will be received by the office of the secretary, Dr. Frank D. Costenbader, 1605 22nd Street, N.W., Washington 8, D.C., and must be accompanied by the examination fee of 25 dollars. Applications will not be accepted after July 1, 1949.

N.S.P.B. meeting

The National Society for the Prevention of Blindness will hold a 3-day national conference at the Hotel New Yorker, New York City, on March 16th, 17th, and 18th. The theme of the meeting will be "The battle against blindness: The next 40 years," and the following subjects will be discussed: "Eye problems in middle life," "The eyes of children and young adults," "Vision in industry," "Medical advances in sight conservation," and "Glaucoma: A community problem."

Miscellaneous

Orthoptic school

A school of orthoptics has been started at the Massachusetts Eye and Ear Infirmary in conjunction with Simmons College in Boston. Students at the college, during the first three years, take courses that will give them an adequate scientific background. Their fourth year is spent at the hospital where practical and didactic work in orthoptics and perimetry is given. This 4-year program leads to the degree of Bachelor of Science and the Diploma in Orthoptics. Miss Ann Stromberg is technical director of the practical aspects of the work at the hospital.

Better Vision Institute

A record attendance of 81 members and guests marked the January 21st meeting of the Better Vision Institute in New York City. Mr. M. J. Julian, president, spoke of the new program which is being designed to combat the misinformation that has been spread regarding the practices of the ophthalmic industry, particularly along economic lines.

Societies

Cleveland meetings

The guest speaker for the January dinner meeting of the Cleveland Ophthalmological Club was Dr. Richard G. Scobee, director of graduate study in ophthalmology, Washington University, Saint Louis, who spoke on "Versions: The case against prisms." Dr. Scobee's presentation was most instructive and interesting and was illustrated by excellent lantern slides.

Dr. James S. Shipman, clinical professor, Graduate School of Ophthalmology, University of Pennsylvania, and attending surgeon at Wills Hospital, was the speaker at the first dinner meeting of the club in November. Dr. Shipman spoke on "Some practical points regarding retinal detachment surgery." His talk was most practical and he brought out several new points in the treatment of detachment of the retina. A lively discussion followed his presentation.

Brooklyn program

Papers presented at the 107th regular meeting of the Brooklyn Ophthalmological Society on February 17th were: "Psychology of cataract sur-

gery considered from the standpoints of surgeon and patient," Dr. Daniel B. Kirby, New York; and "Some unusual optic nerve conditions which may be confused with papilledema," Dr. Frank B. Walsh, Baltimore. During the instruction session, Dr. Charles A. Perera, New York, spoke on "The pathology and treatment of retinal detachment."

Southern Research section

On October 26, 1948, during the meeting of the Southern Medical Association in Miami, Florida, the southern section of the Association for Research in Ophthalmology was organized. Dr. Conrad Berens gave a brief resume of the development and achievements of the national association. Dr. George Haik presented further work on "Beta irradiation for glaucoma." Dr. Alston Callahan, Birmingham, Alabama, was asked to serve as chairman of the southern section for the coming year.

The following ophthalmologists attended: Dr. Conrad Berens, Dr. Shaler Richardson, Dr. George Haik, Dr. William Sayad, Dr. Don Boles, Dr. Johnson, Dr. William Hester, Dr. Karl Benkwith, Dr. Sam McPherson, Dr. Carl Dunaway, Dr. Stacy Howell, Dr. Curtis Benton, Jr., Dr. Hugh Parsons, Dr. E. R. Veirs, Dr. Frank Costenbader, Dr. Mason Baird, Dr. Philip M. Lewis, and Dr. Alston Callahan.

Reading meetings

The 88th and 89th regular meetings of the Reading Eye, Ear, Nose, and Throat Society were held on January 5th and 19th. Dr. N. A. Karakashian, of Philadelphia, spoke on "Practical perimetry," at the first meeting; Dr. E. Gerard Smith of Lancaster, Pennsylvania, discussed "The principles of gonioscopy," at the second meeting.

Milwaukee speaker

Dr. I. E. Gaynon was the ophthalmic speaker at the January 25th meeting of the Milwaukee Oto-Ophthalmic Society. His subject was "Herpes zoster disciform keratitis."

Florida annual meeting

The 10th annual meeting of the Florida Society of Ophthalmology and Otolaryngology will take place at the Belleview-Biltmore Hotel, Belleair, Florida, on April 10th. The address of welcome will be delivered by the president, Dr. Bascom H. Palmer, Miami. A paper, "Benign tumors of the esophagus," will be given by Dr. Thomas M. Edwards, Tampa, and discussed by Dr. Joseph W. Taylor and Dr. C. Frank Chunn, Tampa.

Dr. Charles W. Boyd, Jacksonville, will present a paper on "Corneal section and suture in cataract operation," which will be discussed by Dr. Walton B. Wall, Jr., Orlando, and Dr. Sherman B. Forbes, Tampa. The annual report of the Florida Council for the Blind will be made by the executive secretary, M. Robert Barnett, of Tampa.

At the evening session, Dr. Algernon B. Reese of New York will present a paper on "The treatment of tumors of the eye and adnexa," and Dr. Louis H. Clerf of Philadelphia will speak on "Paralysis of the larynx."

Orthoptic technicians meet

The western group of the American Association of Orthoptic Technicians met at the University of California Hospital, San Francisco, on February 18th and 19th.

Pennsylvania program

The annual meeting of the Pennsylvania Academy of Ophthalmology and Otolaryngology will be held April 22nd, 23rd and 24th, at the Penn Harris Hotel, Harrisburg.

Among the speakers who will present papers at this meeting will be Dr. A. D. Ruedemann, Dr. J. R. Lindsay, Dr. R. O. Rychener, Dr. C. S. Nash, Dr. J. G. Linn, Dr. Arno Town, and Dr. G. M. Coates.

In addition to formal presentations, the meeting will include a round table discussion on "Headaches" which will include representatives of all major specialties, and there will be a study club to discuss "Cataract problems," the discussers to include Dr. Ruedemann, Dr. Rychener, and Dr. Town.

The officers are: President, Dr. James J. Monahan; president elect, Dr. Daniel S. Destio; secretary, Dr. Benjamin F. Souders.

Egyptian meeting

The annual meeting of the Ophthalmological Society of Egypt was held at the Memorial Ophthalmic Library, Giza, Egypt, on March 4th and 5th.

Personals

Dr. Everett L. Goar, Houston, Texas, presented the fifth annual Sanford R. Gifford Memorial Lecture before the Chicago Ophthalmological Society on January 17. The subject of Dr. Goar's paper was "Corneal dystrophies."

Dr. F. Herbert Haessler, Milwaukee, abstract editor of the JOURNAL, has been appointed professor of ophthalmology at the Marquette University School of Medicine.

Dr. Saul Kottler, Cleveland, announces the opening of his office in the Guardian Building. Dr. Kottler recently completed his interneship in the ophthalmological division of the University Hospitals, Cleveland.

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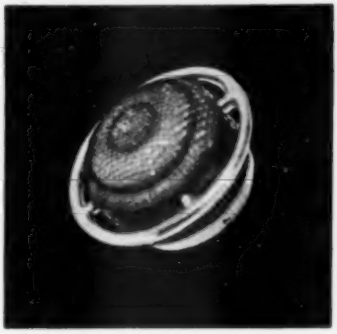

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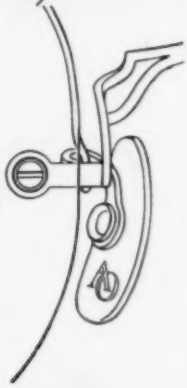

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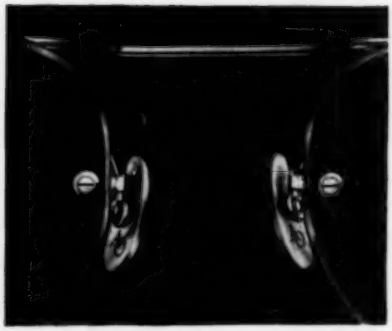

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